



Service Manual

(Serial No. 240000001 and Above)

Workman[®] 3000/4000 Series

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Workman 3000/4000 Series vehicles.

REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manuals and Parts Catalogs for your vehicle. Replacement Operator's Manuals are available on the internet at www.toro.com.

The Toro Company reserves the right to change product specifications or this publication without notice.



This safety symbol means DANGER, WARNING, or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.

NOTE: A **NOTE** will give general information about the correct operation, maintenance, service, testing, or repair of the machine.

IMPORTANT: The **IMPORTANT** notice will give important instructions which must be followed to prevent damage to systems or components on the machine.



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Safety

Product Records
and Maintenance

Briggs/Daihatsu
Gasoline Engine

Briggs/Daihatsu
Diesel Engine

Kohler
Gasoline Engine

Drive Train

Chassis

Electrical
System

Hydraulic
System

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Chapter 1

Safety

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Safety Instructions

The Workman 3000/4000 series vehicles are designed and tested to offer safe service when operated and maintained properly. Although hazard control and accident prevention are partially dependent upon the design and configuration of the vehicle, these factors are also dependent upon the awareness, concern, and proper training of the personnel involved in the operation, transport, maintenance, and storage of the vehicle. Improper use or maintenance of the vehicle can result in injury or

death. To reduce the potential for injury or death, comply with the following safety instructions.



WARNING

To reduce the potential for injury or death, comply with the following safety instructions.

Before Operating

1. Read and understand the contents of the Operator's Manual and Operator's Video before starting and operating the vehicle. Become familiar with the controls and know how to stop the vehicle and engine quickly. A replacement Operator's Manual is available on the Internet at www.Toro.com.
2. Keep all shields, safety devices, and decals in place. If a shield, safety device, or decal is defective, illegible or damaged, repair or replace it before operating the vehicle. Also tighten any loose nuts, bolts or screws to ensure vehicle is in safe operating condition.
3. Assure interlock switches are adjusted correctly so engine cannot be started unless clutch pedal is depressed. On TC models, engine should start only when hydraulic lever is in the neutral position. On vehicles equipped with the optional PTO kit, engine should start only when PTO is disengaged.

4. Since fuel used in Workman vehicles is highly flammable, handle it carefully:

- A. Store fuel in containers specifically designed for this purpose.
- B. Do not remove vehicle fuel tank cap while engine is hot or running.
- C. Do not smoke while handling fuel.
- D. Fill fuel tank outdoors and only to within an inch of the top of the tank, not the filler neck. Do not overfill the fuel tank.
- E. Wipe up any spilled fuel.

While Operating

1. Sit on the seat when starting and operating the vehicle.
2. Before starting the engine:
 - A. Sit on operator's seat and engage the parking brake.
 - B. Disengage PTO (if so equipped) and return hand throttle lever to OFF position (if so equipped).
 - C. On TC models, make sure that hydraulic lever is in the neutral position.
 - D. Move shift lever to NEUTRAL and depress clutch pedal. Keep foot off accelerator pedal.
 - E. Turn ignition key to START.
3. Do not run engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could possibly be deadly.
4. Do not touch engine, radiator, muffler or exhaust pipe while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.
5. Before getting off the seat:
 - A. Stop movement of the vehicle.
 - B. Lower bed.
 - C. Shut engine off and wait for all movement to stop.
 - D. Set parking brake and remove key from ignition switch.
 - E. Do not park on slopes unless wheels are chocked or blocked.

Maintenance and Service

1. Before servicing or making adjustments, turn all accessories off, put traction pedal in neutral, stop engine, set parking brake, and remove key from the switch.
2. Make sure vehicle is in safe operating condition by keeping all nuts, bolts and screws tight.
3. Never store the vehicle or fuel container inside where there is an open flame, such as near a water heater or furnace.
4. Make sure all hydraulic line connectors are tight and that all hydraulic hoses and lines are in good condition, before applying pressure to the system.
5. Keep body and hands away from pin hole leaks in hydraulic lines that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks. Hydraulic fluid escaping under pressure can penetrate skin and cause injury. Fluid accidentally injected into the skin must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.
6. Before disconnecting or performing any work on the hydraulic system, all pressure in hydraulic system must be relieved. To relieve system pressure, push dump lever forward and backward and rotate steering wheel in both directions after the key switch has been turned off.
7. If major repairs are ever needed or assistance is desired, contact an Authorized Toro Distributor.
8. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt. Clean protective screen on vehicle frequently.
9. If engine must be running to perform maintenance or an adjustment, keep clothing, hands, feet, and other parts of the body away from moving parts. Keep bystanders away.
10. Do not overspeed the engine by changing governor setting. To assure safety and accuracy, check maximum engine speed.
11. Shut engine off before checking or adding oil to the engine crankcase.
12. Disconnect battery before servicing the vehicle. Disconnect negative (–) battery cable first and positive (+) cable last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery. Reconnect positive (+) cable first and negative (–) cable last.
13. Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes, and clothing. Protect your face, eyes, and clothing when working with a battery.
14. Battery gases can explode. Keep cigarettes, sparks, and flames away from the battery.
15. To assure optimum performance and continued safety of the vehicle, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in non-conformance with safety standards, and the warranty may be voided.
16. When raising the vehicle to change tires or to perform other service, use correct blocks, hoists, and jacks. Make sure vehicle is parked on a solid level surface such as a concrete floor. Prior to raising the vehicle, remove any attachments that may interfere with the safe and proper raising of the vehicle. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised vehicle. If the vehicle is not properly supported by blocks or jack stands, the vehicle may move or fall, which may result in personal injury (see Jacking Instructions in Operator's Manual).

Jacking Vehicle



WARNING

When changing attachments, tires or performing other service, use the correct blocks, hoists and jacks. Always chock or block the wheels and use jack stands or solid wood blocks to support the vehicle. If the vehicle is not properly supported by blocks or jack stands, the vehicle may move or fall resulting in personal injury.

1. Do not start engine while vehicle is on jack, because engine vibration or wheel movement could cause vehicle to slip off jack.
2. Do not work under vehicle without jack stands supporting it. The vehicle could slip off jack, injuring any one beneath it.
3. The jacking point at the front of the vehicle is under the front center frame support and at the rear it is under the axle tube.
4. When jacking up front of vehicle, always place a wood block (or similar material) between jack and vehicle frame support.

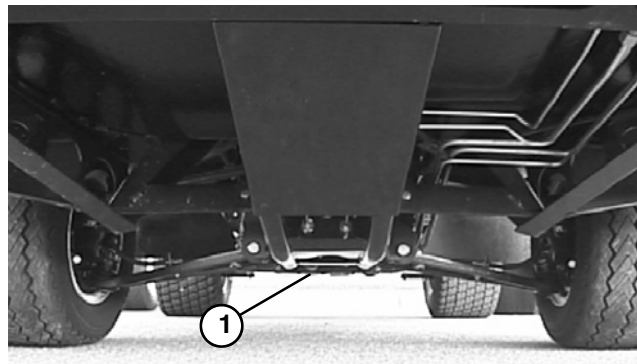


Figure 1

1. Front jacking point

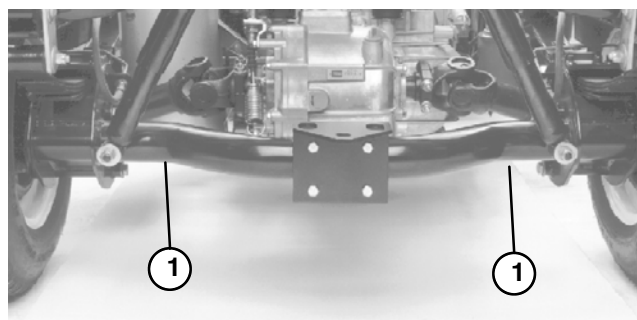


Figure 2

1. Rear jacking point

Using Bed Safety Support

Many of the procedures shown in this manual require raising and lowering the bed. The following precautions must be taken or serious injury or death could result.



WARNING

Before servicing or making adjustments to the vehicle, stop engine, set parking brake and remove key from ignition switch. Any load material must be removed from bed or other attachment before working under raised bed. Never work under a raised bed without positioning bed safety support on a fully installed cylinder rod.

After work is completed, remove bed safety support, insert into storage brackets on back of ROPS panel and lower bed.

1. Raise bed until lift cylinders are fully extended.
2. Remove bed safety support from storage brackets on back of ROPS panel.
3. Push bed safety support onto cylinder rod, making sure support end tabs rest on end of cylinder barrel and on cylinder rod end (Fig. 3).
4. To store bed safety support, remove support from cylinder and insert into storage brackets on back of ROPS panel.
5. Always install or remove bed safety support from outside of bed.
6. Do not try to lower bed with bed safety support on cylinder: cylinder and bed damage may occur.

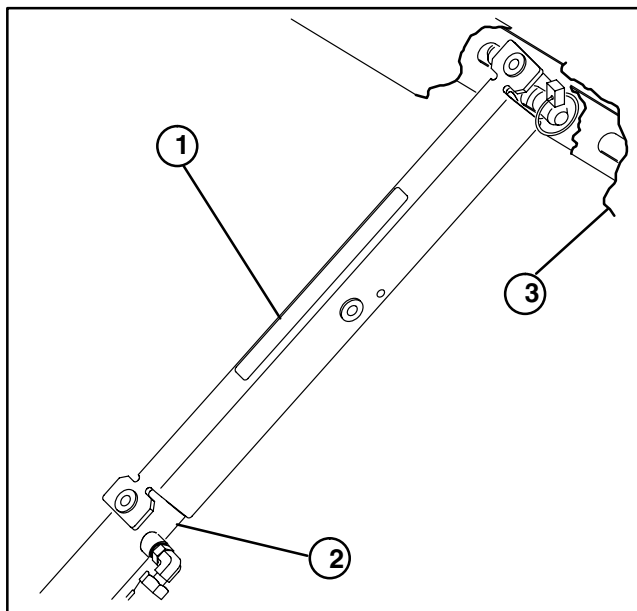


Figure 3

- | | |
|-----------------------|--------|
| 1. Bed safety support | 3. Bed |
| 2. Cylinder barrel | |



Product Records and Maintenance

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Product Records

Insert Operator's Manual and Parts Catalog for your Workman at the end of this chapter. Refer to Operator's Manual for recommended maintenance intervals. Additionally, insert Installation Instructions, Operator's Manuals, Parts Catalogs and Service Manuals for any accessories that have been installed on your Workman at the end of this section.

Equivalents and Conversions

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm
1/64	0.015625	— 0.397	33/64	0.515625	— 13.097
1/32	0.03125	— 0.794	17/32	0.53125	— 13.494
3/64	0.046875	— 1.191	35/64	0.546875	— 13.891
1/16	0.0625	— 1.588	9/16	0.5625	— 14.288
5/64	0.078125	— 1.984	37/64	0.578125	— 14.684
3/32	0.09375	— 2.381	19/32	0.59375	— 15.081
7/64	0.109375	— 2.778	39/64	0.609375	— 15.478
1/8	0.1250	— 3.175	5/8	0.6250	— 15.875
9/64	0.140625	— 3.572	41/64	0.640625	— 16.272
5/32	0.15625	— 3.969	21/32	0.65625	— 16.669
11/64	0.171875	— 4.366	43/64	0.671875	— 17.066
3/16	0.1875	— 4.762	11/16	0.6875	— 17.462
13/64	0.203125	— 5.159	45/64	0.703125	— 17.859
7/32	0.21875	— 5.556	23/32	0.71875	— 18.256
15/64	0.234375	— 5.953	47/64	0.734375	— 18.653
1/4	0.2500	— 6.350	3/4	0.7500	— 19.050
17/64	0.265625	— 6.747	49/64	0.765625	— 19.447
9/32	0.28125	— 7.144	25/32	0.78125	— 19.844
19/64	0.296875	— 7.541	51/64	0.796875	— 20.241
5/16	0.3125	— 7.938	13/16	0.8125	— 20.638
21/64	0.328125	— 8.334	53/64	0.828125	— 21.034
11/32	0.34375	— 8.731	27/32	0.84375	— 21.431
23/64	0.359375	— 9.128	55/64	0.859375	— 21.828
3/8	0.3750	— 9.525	7/8	0.8750	— 22.225
25/64	0.390625	— 9.922	57/64	0.890625	— 22.622
13/32	0.40625	— 10.319	29/32	0.90625	— 23.019
27/64	0.421875	— 10.716	59/64	0.921875	— 23.416
7/16	0.4375	— 11.112	15/16	0.9375	— 23.812
29/64	0.453125	— 11.509	61/64	0.953125	— 24.209
15/32	0.46875	— 11.906	31/32	0.96875	— 24.606
31/64	0.484375	— 12.303	63/64	0.984375	— 25.003
1/2	0.5000	— 12.700	1	1.000	— 25.400
1 mm = 0.03937 in.			0.001 in. = 0.0254 mm		

U.S.to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
	Pounds/Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract 32°
			2. Multiply by 5/9

Torque Specifications

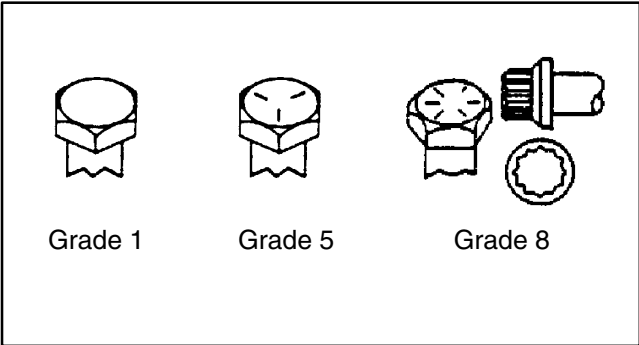
Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

These Torque Specifications for the installation and tightening of fasteners shall apply to all fasteners which do not have a specific requirement identified in this Service Manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature, hardness of the surface underneath the fastener's head, or similar condition which affects the installation.

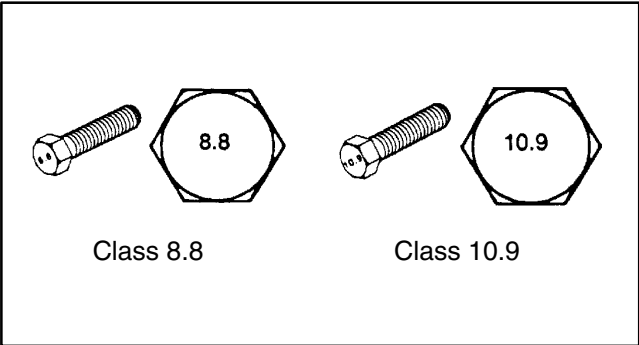
As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification



Inch Series Bolts and Screws



Metric Bolts and Screws

Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Inch Series Fasteners)

Thread Size	Grade 1, 5, & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in-lb	in-lb	N-cm	in-lb	N-cm	in-lb	N-cm
# 6 – 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	170 ± 20	23 ± 2	260 ± 20
# 6 – 40 UNF				17 ± 2	190 ± 20	25 ± 2	280 ± 20
# 8 – 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	330 ± 30	41 ± 4	460 ± 45
# 8 – 36 UNF				31 ± 3	350 ± 30	43 ± 4	485 ± 45
# 10 – 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 4	475 ± 45	60 ± 6	675 ± 70
# 10 – 32 UNF				48 ± 4	540 ± 45	68 ± 6	765 ± 70
1/4 – 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1125 ± 100	140 ± 15	1580 ± 170
1/4 – 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 10	1300 ± 100	160 ± 15	1800 ± 170
5/16 – 18 UNC	115 ± 15	105 ± 17	1186 ± 169	200 ± 25	2250 ± 280	300 ± 30	3390 ± 340
5/16 – 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2540 ± 280	325 ± 30	3670 ± 340
	ft-lb	ft-lb	N-m	ft-lb	N-m	ft-lb	N-m
3/8 – 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 4	58 ± 5
3/8 – 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 3	47 ± 4	50 ± 4	68 ± 5
7/16 – 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16 – 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 5	75 ± 7	77 ± 7	104 ± 9
1/2 – 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 10	142 ± 14
1/2 – 20 UNF	32 ± 3	53 ± 7	72 ± 9	85 ± 8	115 ± 11	120 ± 10	163 ± 14
5/8 – 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 20	285 ± 27
5/8 – 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 15	230 ± 20	240 ± 20	325 ± 27
3/4 – 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 25	359 ± 34	375 ± 35	508 ± 47
3/4 – 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 25	407 ± 34	420 ± 35	569 ± 47
7/8 – 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 – 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 45	644 ± 61	660 ± 60	895 ± 81

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite, or thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based

on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Fasteners)

Thread Size	Class 8.8 Bolts, Screws, and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws, and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)	
M5 X 0.8	57 ± 5 in-lb	640 ± 60 N-cm	78 ± 7 in-lb	885 ± 80 N-cm
M6 X 1.0	96 ± 9 in-lb	1018 ± 100 N-cm	133 ± 13 in-lb	1500 ± 150 N-cm
M8 X 1.25	19 ± 2 ft-lb	26 ± 3 N-m	27 ± 2 ft-lb	36 ± 3 N-m
M10 X 1.5	38 ± 4 ft-lb	52 ± 5 N-m	53 ± 5 ft-lb	72 ± 7 N-m
M12 X 1.75	66 ± 7 ft-lb	90 ± 10 N-m	92 ± 9 ft-lb	125 ± 12 N-m
M16 X 2.0	166 ± 15 ft-lb	225 ± 20 N-m	229 ± 22 ft-lb	310 ± 30 N-m
M20 X 2.5	325 ± 33 ft-lb	440 ± 45 N-m	450 ± 37 ft-lb	610 ± 50 N-m

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite, or thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based

on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

Thread Size	Recommended Torque	
	Square Head	Hex Socket
1/4 – 20 UNC	140 ± 20 in-lb	73 ± 12 in-lb
5/16 – 18 UNC	215 ± 35 in-lb	145 ± 20 in-lb
3/8 – 16 UNC	35 ± 10 ft-lb	18 ± 3 ft-lb
1/2 – 13 UNC	75 ± 15 ft-lb	50 ± 10 ft-lb

Wheel Bolts and Lug Nuts

Thread Size	Recommended Torque**	
7/16 – 20 UNF Grade 5	65 ± 10 ft-lb	88 ± 14 N-m
1/2 – 20 UNF Grade 5	80 ± 10 ft-lb	108 ± 14 N-m
M12 X 1.25 Class 8.8	80 ± 10 ft-lb	108 ± 14 N-m
M12 X 1.5 Class 8.8	80 ± 10 ft-lb	108 ± 14 N-m

** For steel wheels and non-lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

Type 1, Type 23, or Type F	
Thread Size	Baseline Torque*
No. 6 – 32 UNC	20 ± 5 in-lb
No. 8 – 32 UNC	30 ± 5 in-lb
No. 10 – 24 UNC	38 ± 7 in-lb
1/4 – 20 UNC	85 ± 15 in-lb
5/16 – 18 UNC	110 ± 20 in-lb
3/8 – 16 UNC	200 ± 100 in-lb

Thread Cutting Screws (Zinc Plated Steel)

Thread Size	Threads per Inch		Baseline Torque*
	Type A	Type B	
No. 6	18	20	20 ± 5 in-lb
No. 8	15	18	30 ± 5 in-lb
No. 10	12	16	38 ± 7 in-lb
No. 12	11	14	85 ± 15 in-lb

* Hole size, material strength, material thickness & finish must be considered when determining specific torque values. All torque values are based on non-lubricated fasteners.

Conversion Factors

$$\begin{aligned} \text{in-lb} \times 11.2985 &= \text{N-cm} \\ \text{ft-lb} \times 1.3558 &= \text{N-m} \end{aligned}$$

$$\begin{aligned} \text{N-cm} \times 0.08851 &= \text{in-lb} \\ \text{N-m} \times 0.7376 &= \text{ft-lb} \end{aligned}$$

Maintenance

Maintenance procedures and recommended service intervals for the Workman 3000/4000 are covered in the Operator's Manual. Refer to that publication when performing regular equipment maintenance. Several maintenance procedures have break-in intervals identified in the Operator's Manual. Refer to the Engine Operator's Manual for additional engine specific maintenance procedures.

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Briggs/Daihatsu Gasoline Engine

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Introduction

This Chapter gives information about specifications and repair of the Briggs & Stratton/Daihatsu 3LC gasoline engine used in the Workman 3200 and 4200.

General engine maintenance procedures are described in your Operator's Manual. Information on engine troubleshooting, testing, disassembly, and reassembly is identified in the Briggs & Stratton/Daihatsu Repair Manual that is included at the end of this section.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Briggs & Stratton/Daihatsu Repair Manual. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Briggs & Stratton/Daihatsu 3LC gasoline engines are supplied through your local Toro distributor.

Specifications

Item	Description
Make / Designation	Briggs & Stratton/Daihatsu, 4–stroke, Liquid Cooled, OHV Gasoline
Number of Cylinders	3
Bore x Stroke mm (in.)	72 x 78 (2.834 x 3.07)
Total Displacement cc (cu. in.)	952 (58.1)
Compression Ratio	8.6:1
Firing Order	1 (front) – 2 – 3
Dry Weight (approximate) kg (lb.)	62 (137)
Carburetor	Single barrel, float feed, 12 VDC shut–off solenoid
Fuel Pump	12 VDC
Fuel	Unleaded, regular grade (87 octane minimum)
Fuel Tank Capacity liter (U.S. gal.)	26 (7)
Governor	Mechanical
Idle Speed (no load)	1100 ± 50 RPM
High Idle (no load)	3600 ± 50 RPM
Engine Oil	API Service Classification SH or better (see Operator's Manual for viscosity)
Oil Pump	Gear driven trochoid type
Crankcase Oil Capacity liter (U.S. qt.)	3.3 (3.5) with filter
Water Pump	Belt driven centrifugal type
Cooling System Capacity liter (U.S. qt.)	3.8 (4.0)
Starter	12 VDC
Alternator/Regulator	12 VDC 40 AMP

General Information

Adding Oil to Engine

When adding oil to the engine, maintain clearance between the oil fill device and the oil fill opening in the valve cover (Fig. 1). This clearance is necessary to allow venting when adding engine oil which will prevent oil from running into the breather tube and intake system.

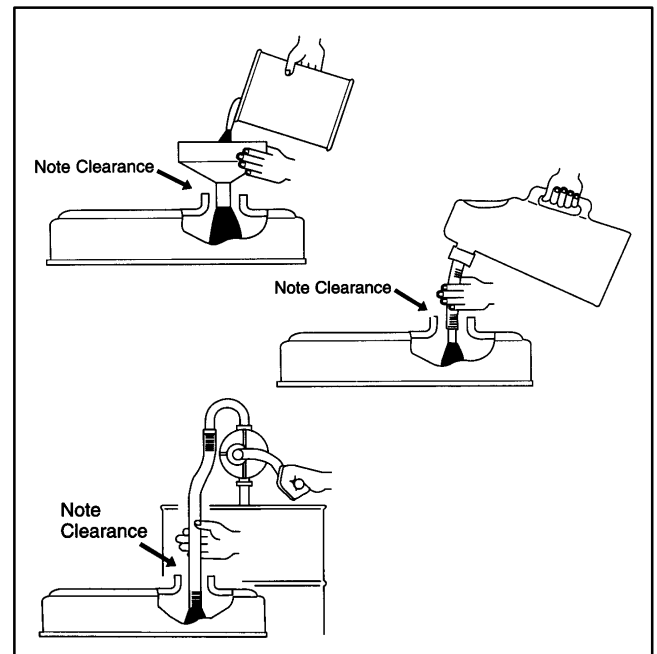


Figure 1

Adjustments

Engine Speed Adjustment

1. Park vehicle on a level surface, engage parking brake and place gear shift lever in neutral.
2. Raise the bed or remove attachment(s) to allow access to engine. If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Stop engine and remove key from the ignition switch.
4. Make sure governor spring is assembled to bellcrank on throttle bracket and outer most slot in engine governor lever (Fig. 2).
5. Check low idle stop screw adjustment (Figs. 3, 4 and 5). Proper low idle stop screw adjustment will prevent engine run on when the accelerator pedal is released:
 - A. Remove return spring from throttle bracket and bellcrank. Disconnect throttle cable from balljoint on bellcrank.
 - B. Move the governor lever to its rearmost position and check that the governor spring is loose in the slot on the engine governor lever. Also, check that the rear edge of the bellcrank is against the low idle stop screw. Release governor lever.
 - C. Position the rear edge of the bellcrank so it is 0.125 in. (3.2 mm) from the head of the low idle stop screw (Fig. 4). At this position, the governor spring must be tight against the upper edge of the engine governor lever slot with no extension of the spring coils. If necessary, adjust low idle stop screw and/or governor spring adjusting rod (if equipped) to allow correct governor spring positioning.
 - D. Install return spring to throttle bracket and bellcrank. Connect throttle cable to balljoint on bellcrank.
6. Check operation and adjustment of accelerator cable (see Operator's Manual). If needed, adjust accelerator cable.
7. Start and run engine until engine is at normal operating temperature. Make sure that carburetor choke is fully open.

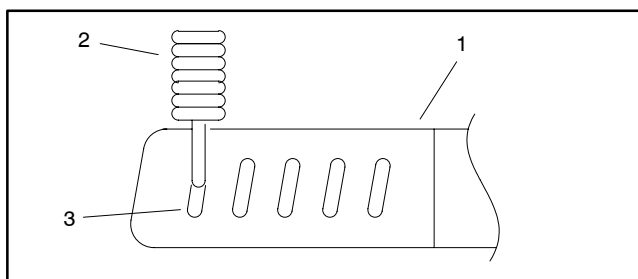


Figure 2

- | | |
|--------------------------|-------------------------|
| 1. Engine governor lever | 3. Spring mounting slot |
| 2. Governor spring | |

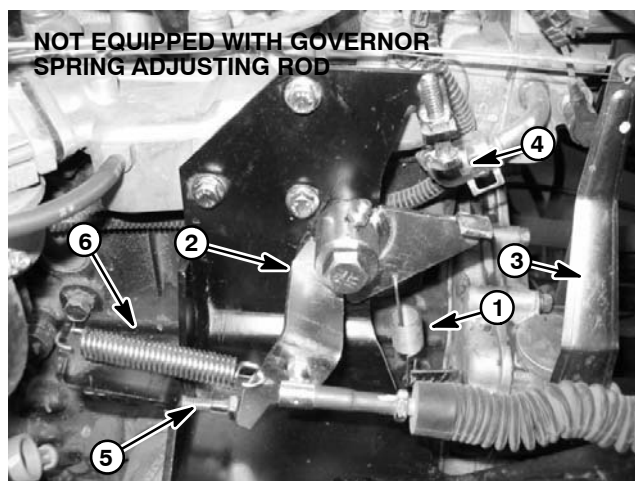


Figure 3

- | | |
|--------------------------|-------------------------|
| 1. Governor spring | 4. High idle stop screw |
| 2. Bellcrank | 5. Low idle stop screw |
| 3. Engine governor lever | 6. Return spring |

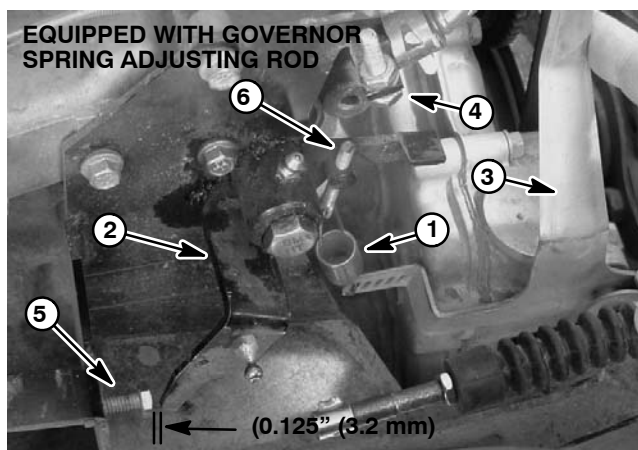


Figure 4

- | | |
|--------------------------|-------------------------|
| 1. Governor spring | 4. High idle stop screw |
| 2. Bellcrank | 5. Low idle stop screw |
| 3. Engine governor lever | 6. Spring adjusting rod |

8. Using a tachometer, check low idle speed. Low idle speed should be 1100 ± 50 RPM. If low idle is incorrect, repeat idle stop screw adjustment (step 5). If low idle is still incorrect, adjust the idle speed screw on the carburetor to obtain 1100 ± 50 RPM (Fig. 6).

9. Check high idle speed. High idle speed should be 3600 ± 50 RPM. Reposition the high idle stop screw to adjust high idle speed. Make sure to tighten lock nut after adjusting high idle stop screw.

10. After engine speed adjustments are complete, lower the bed or install attachment(s).

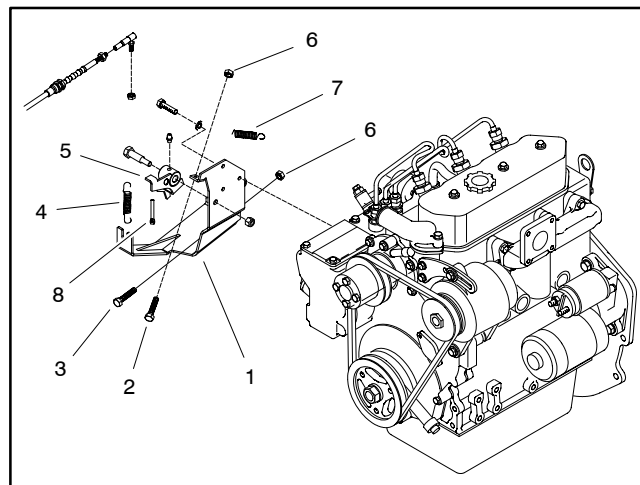


Figure 5

- | | |
|-------------------------|--------------------------|
| 1. Throttle bracket | 5. Bellcrank |
| 2. High idle stop screw | 6. Jam nut |
| 3. Idle stop screw | 7. Return spring |
| 4. Governor spring | 8. Adj rod (if equipped) |

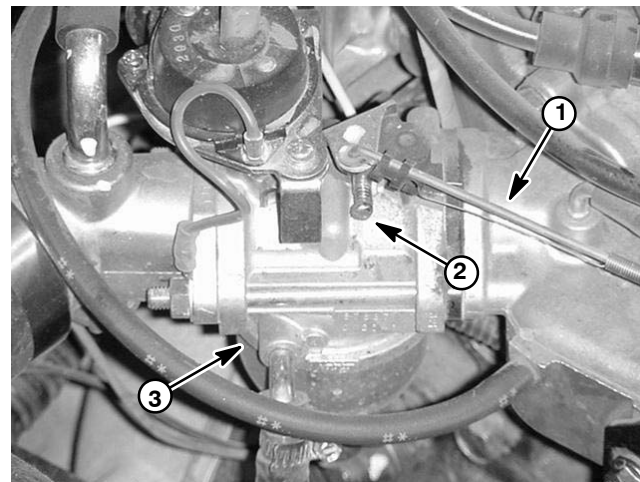


Figure 6

- | | |
|---------------------|---------------|
| 1. Governor link | 3. Carburetor |
| 2. Idle speed screw | |

Service and Repairs

Radiator

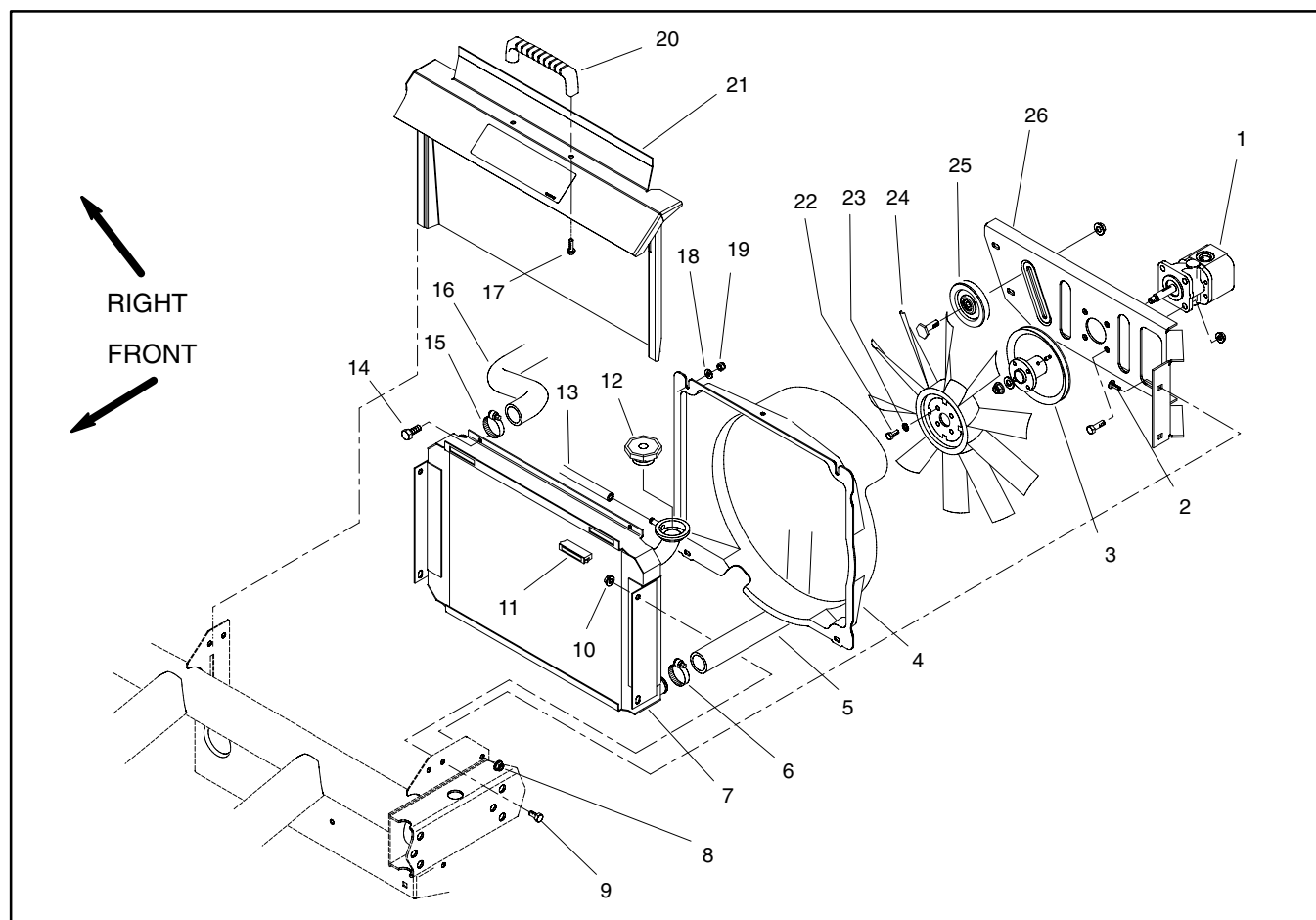
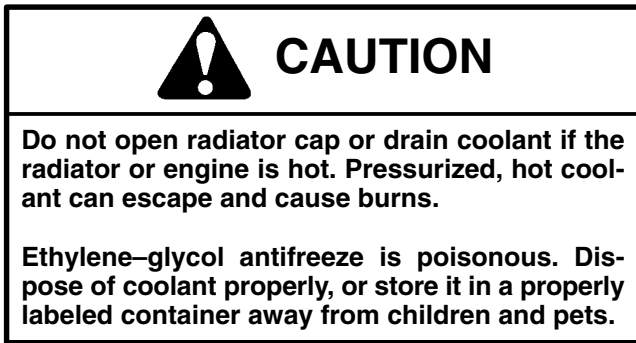


Figure 5

- | | | |
|----------------------------|---------------------------------|---------------------------|
| 1. Hydraulic pump | 10. Flange nut (4 used) | 19. Lock nut (4 used) |
| 2. Carriage screw (4 used) | 11. Magnetic catch (2 used) | 20. Handle |
| 3. Fan hub/pulley | 12. Radiator cap | 21. Radiator cover/screen |
| 4. Fan shroud | 13. Hose (to coolant reservoir) | 22. Cap screw (4 used) |
| 5. Lower radiator hose | 14. Cap screw (4 used) | 23. Lock washer (4 used) |
| 6. Hose clamp | 15. Hose clamp | 24. Fan |
| 7. Radiator | 16. Upper radiator hose | 25. Idler pulley |
| 8. Lock nut (4 used) | 17. Screw (2 used) | 26. Mount plate |
| 9. Cap screw (4 used) | 18. Flat washer | |

Removal (Fig. 5)

1. Park vehicle on a level surface, stop engine, engage parking brake, and remove key from the ignition switch. Allow engine to cool.
2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Lift and remove the radiator screen from front of radiator.



4. Remove the radiator cap. Drain radiator into a suitable container using the radiator drain located on the lower right corner of the radiator.
5. Disconnect upper and lower radiator hoses from the radiator.
6. Disconnect reservoir hose (item 13) from the radiator filler neck.
7. Detach fan shroud from the radiator by removing four (4) cap screws, flat washers and lock nuts. Position shroud away from radiator.
8. Remove four (4) cap screws and flange nuts that secure the radiator to the frame. Pull radiator from the vehicle.
9. Plug all radiator and hose openings to prevent contamination.

Installation (Fig. 5)

1. Remove plugs from radiator and hoses placed during the removal procedure.
2. Position radiator to the frame. Secure radiator to the vehicle with four (4) cap screws and flange nuts.
3. Attach fan shroud to the radiator with four (4) cap screws, flat washers and lock nuts. Make sure that clearance exists between shroud and fan at all points.
4. Connect reservoir hose (item 11) to the radiator filler neck.
5. Connect upper and lower hoses to the radiator.
6. Make sure radiator drain is closed. Fill radiator with coolant (see Operator's Manual).
7. Install the radiator screen.
8. Lower or install bed or other attachment(s).

Pump Driveshaft Service

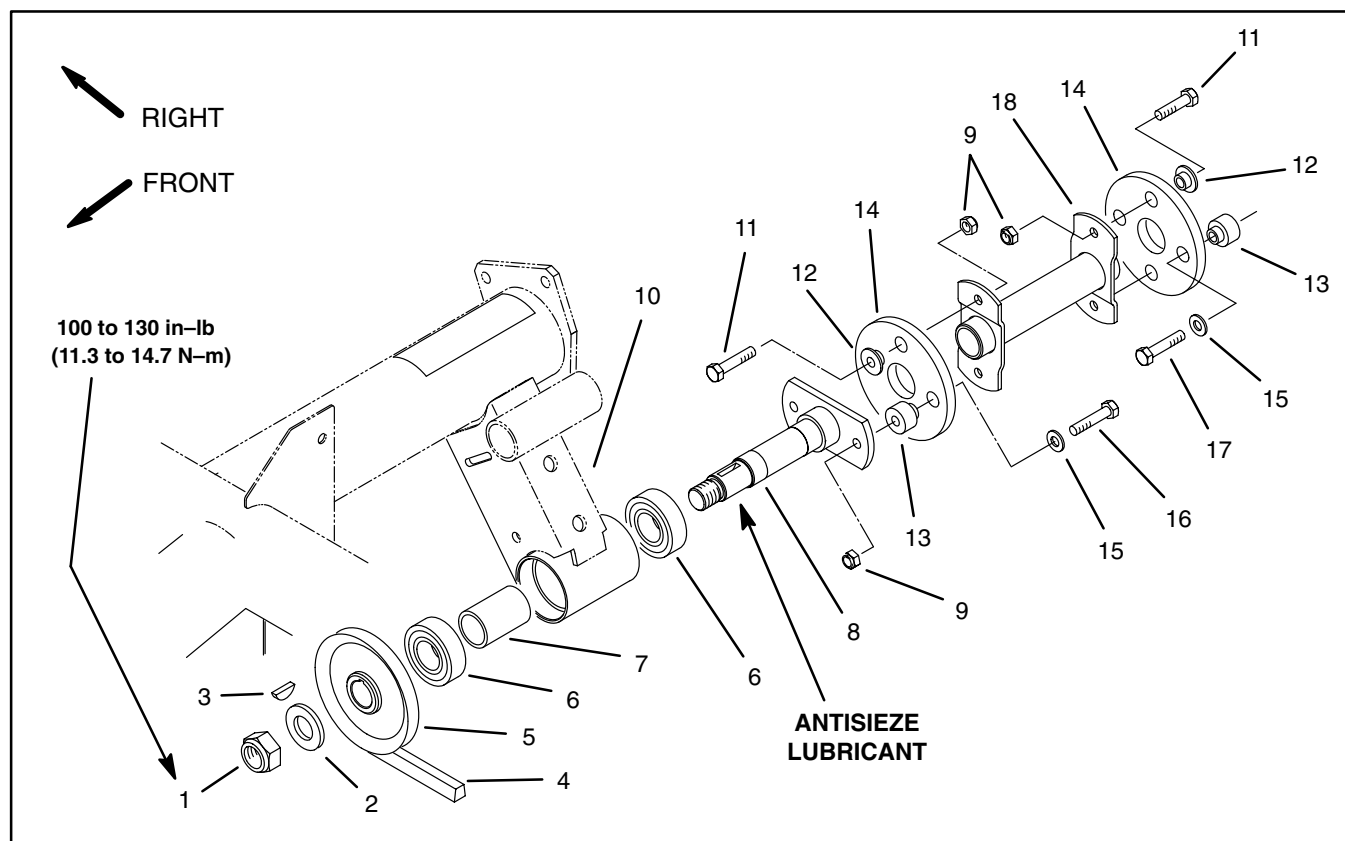


Figure 6

- | | | |
|--------------------|------------------------------|------------------------------|
| 1. Lock nut | 7. Bearing spacer | 13. Coupling spacer (4 used) |
| 2. Flat washer | 8. Shaft | 14. Rubber coupling |
| 3. Woodruff key | 9. Lock nut (6 used) | 15. Flat washer (4 used) |
| 4. Pump drive belt | 10. Frame support bracket | 16. Cap screw (2 used) |
| 5. Pulley | 11. Cap screw (4 used) | 17. Cap screw (2 used) |
| 6. Bearing | 12. Coupling spacer (4 used) | 18. Driveshaft |

Removal (Fig. 6)

1. Park vehicle on a level surface, raise and support bed (if installed), shut engine off and engage the parking brake.
2. Disassemble driveshaft using Figure 6 as a guide.
3. Do not reuse bearings (Item 6) if they have been removed from frame support bracket. Replace with new bearings.

Inspection

1. Inspect frame support bracket for wear or damage.
2. Inspect bearing spacer (Item 7) for wear or damage. Also, check that spacer length is from 1.884" to 1.894" (47.85 to 48.10 mm). Replace spacer if necessary.

Installation (Fig. 6)

1. To install bearings (Item 6) into frame support bracket:
 - A. Install pulley side bearing into support bracket by pressing on bearing outer race until bearing contacts shoulder in support bracket.
 - B. Place the bearing spacer (Item 7) into bracket cavity.
 - C. Install second bearing into bracket by pressing on the bearing outer race until bearing inner race contacts spacer.
2. Slide shaft (Item 8) into installed bearings in frame support bracket. Apply antisieze lubricant to pulley end of shaft before installing woodruff key (Item 3) and pulley (Item 5).
3. Secure pulley to shaft with washer and lock nut. Torque lock nut from 100 to 130 in-lb (11.3 to 14.7 N-m). Make sure that shaft rotates freely after pulley is installed.
4. Assemble driveshaft using Figure 6 as a guide.
5. Adjust pump drive belt tension after assembly (see Operator's Manual).

Fuel Tank

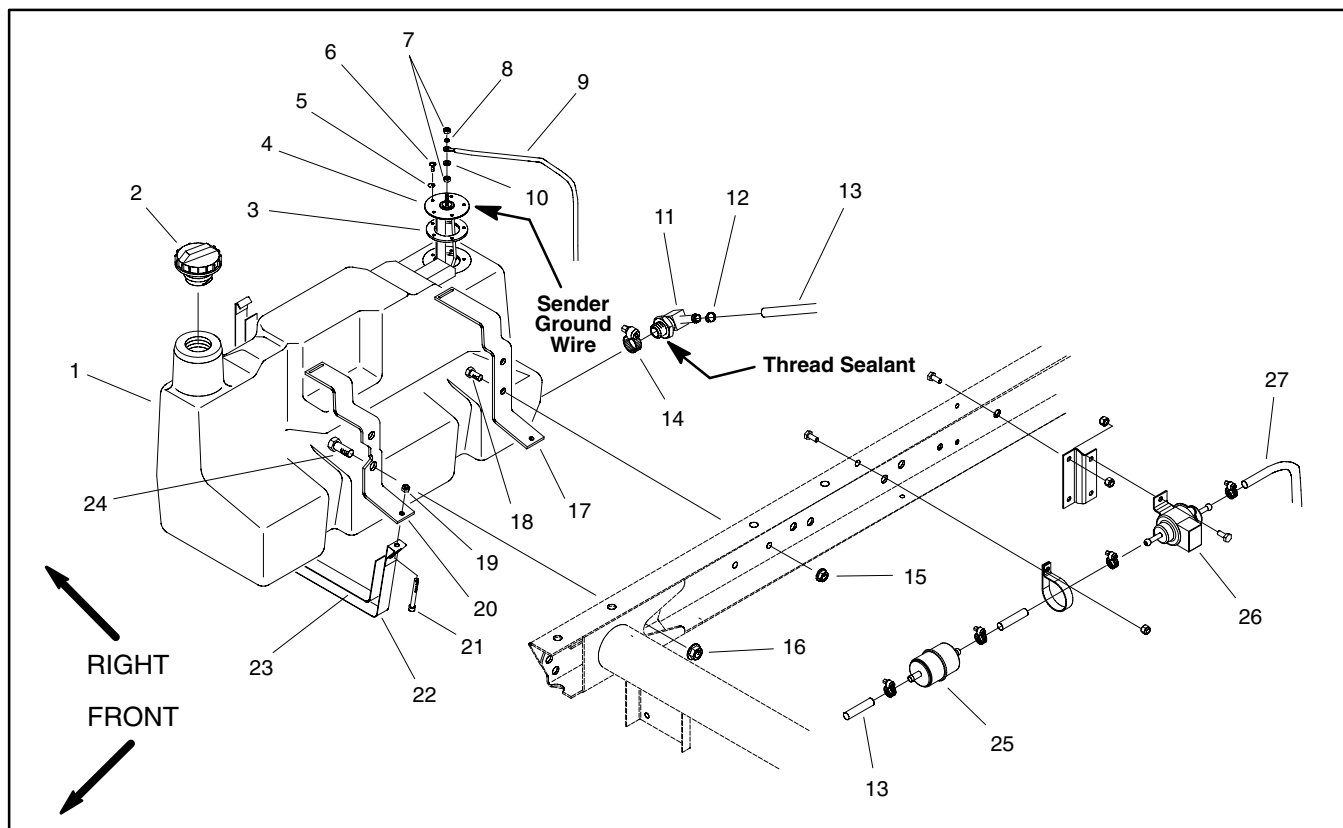


Figure 7

- | | | |
|-------------------------|--------------------------------|--------------------------------|
| 1. Fuel tank | 10. Spacer | 19. Lock nut (2 used) |
| 2. Fuel tank cap | 11. Fuel fitting | 20. Front fuel tank support |
| 3. Gasket | 12. Hose clamp | 21. Socket head screw (2 used) |
| 4. Fuel sender | 13. Fuel hose (to fuel filter) | 22. Fuel tank strap (2 used) |
| 5. Lock washer (5 used) | 14. Clamp | 23. Felt strap (2 used) |
| 6. Screw (5 used) | 15. Flange nut (2 used) | 24. Cap screw (2 used) |
| 7. Hex nut | 16. Flange nut (2 used) | 25. Fuel filter |
| 8. Lock washer | 17. Rear fuel tank support | 26. Fuel pump |
| 9. Wire harness | 18. Cap screw (2 used) | 27. Fuel line (to engine) |



DANGER

Because gasoline is highly flammable, use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running, hot, or when vehicle is in an enclosed area. Always fill fuel tank outside and wipe up any spilled fuel before starting the engine. Store fuel in a clean, safety-approved container and keep cap in place. Use fuel for the engine only; not for any other purpose.

Check Fuel Lines and Connections

Check fuel lines and connections periodically as recommended in the Operator's Manual. Check lines for deterioration, damage, leaks, or loose connections. Replace hoses, clamps, and connections as necessary.

Fuel Tank Removal (Fig. 7)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.
2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Disconnect negative battery cable first and then positive battery cable. Remove battery from vehicle (see Operator's Manual).

IMPORTANT: Review safety information regarding fuel handling in the Operator's Manual and Chapter 2 – Safety.

4. Disconnect fuel hose (item 13) from fuel filter located on right frame rail. Drain fuel from the fuel tank into a suitable container.

NOTE: To prevent fuel leakage, do not loosen lower nut on fuel sender stud.

5. Disconnect electrical wiring from the fuel sender on the fuel tank.
6. Loosen socket head screws (item 21) and lock nuts (item 19) to allow tank straps to be unhooked from fuel tank supports.
7. Remove fuel tank from vehicle.

Fuel Tank Installation (Fig. 7)

1. Check felt straps (item 23) and replace if worn or damaged.

IMPORTANT: When positioning fuel tank to vehicle, make sure that hydraulic lift cylinder does not contact tank.

2. Position fuel tank to tank straps and fuel tank supports. Hook tank straps to fuel tank supports. Tighten socket head screws and lock nuts to secure fuel tank.

3. If fuel fitting was removed from tank, apply thread sealant to threads of fitting before installing fitting into tank.

4. Connect electrical wiring to the fuel sender.

A. Connect blue/white wire with ring terminal to the center fuel sender terminal and secure with lock washer and hex nut.

B. Connect black (ground) wire with the screw (item 6) that is closest to the frame rail.

C. Apply skin-over grease to the wire terminal connections and cover center terminal with harness boot.

5. Connect fuel hose from tank outlet to fuel filter and secure with clamp.



CAUTION

Connecting battery cables to the wrong battery post could result in personal injury and/or damage to the electrical system.

6. Position battery in vehicle (see Operator's Manual). Connect positive battery cable first and then negative battery cable.

7. Lower or install the bed or other attachment(s).

8. Fill fuel tank (see Operator's Manual). Check for fuel leakage and correct if found.

Air Cleaner System

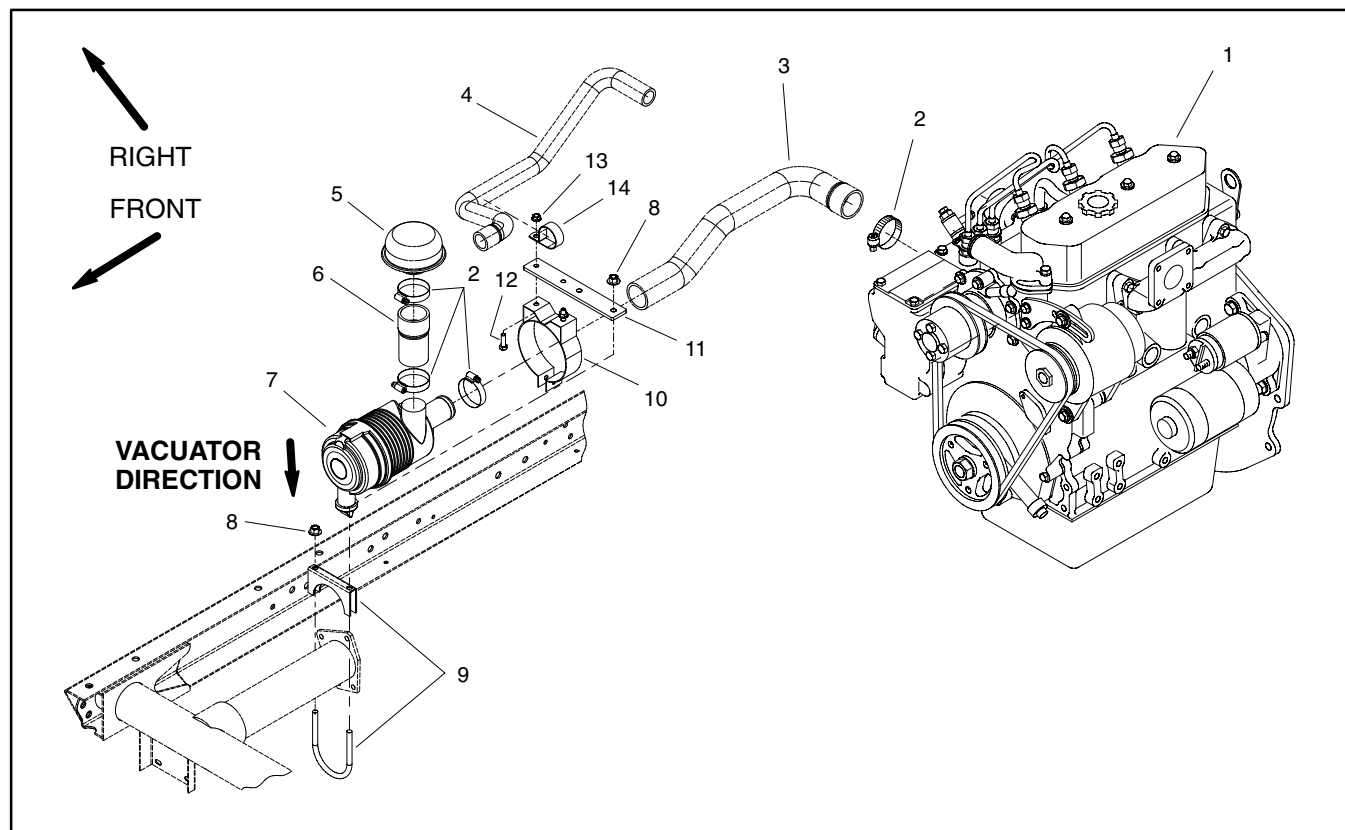


Figure 8

- | | | |
|--------------------|-------------------------|-------------------------|
| 1. Engine | 6. Air cleaner hose | 11. Mount bracket |
| 2. Hose clamp | 7. Air cleaner assembly | 12. Cap screw (2 used) |
| 3. Air intake hose | 8. Flange nut (2 used) | 13. Flange nut (2 used) |
| 4. Radiator hose | 9. Clamp | 14. R-clamp |
| 5. Air inlet hood | 10. Mounting band | |

Removal (Fig. 8)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.
2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Remove air cleaner components as needed using Figures 8 and 9 as guides.

Installation (Fig. 8)

IMPORTANT: Any leaks in the air filter system will cause serious engine damage. Make sure daily that all air cleaner components are in good condition and are properly secured during reassembly.

1. Reassemble air cleaner system using Figures 8 and 9 as guides. Air cleaner hose (item 6) and air inlet hood (item 5) should be positioned straight upward. The vacuator valve on the air cleaner assembly should be positioned downward.
2. Lower or install bed or attachment(s).

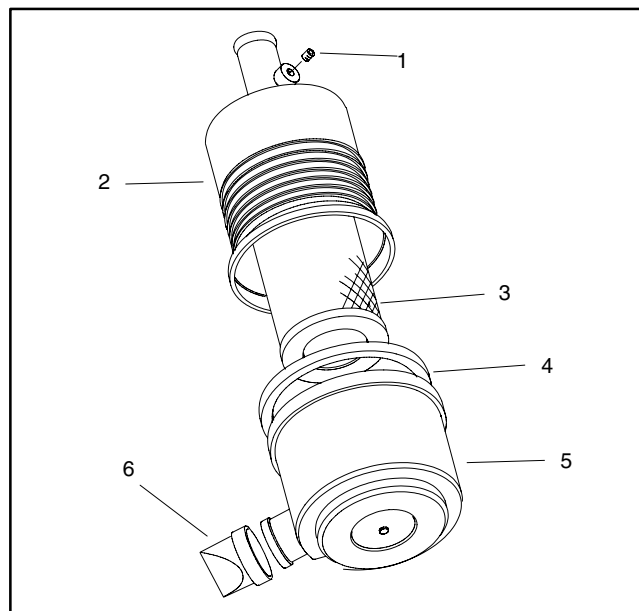


Figure 9

- | | |
|------------------|-------------------|
| 1. Plug | 4. Gasket |
| 2. Upper housing | 5. Lower housing |
| 3. Element | 6. Vacuator valve |

Exhaust System

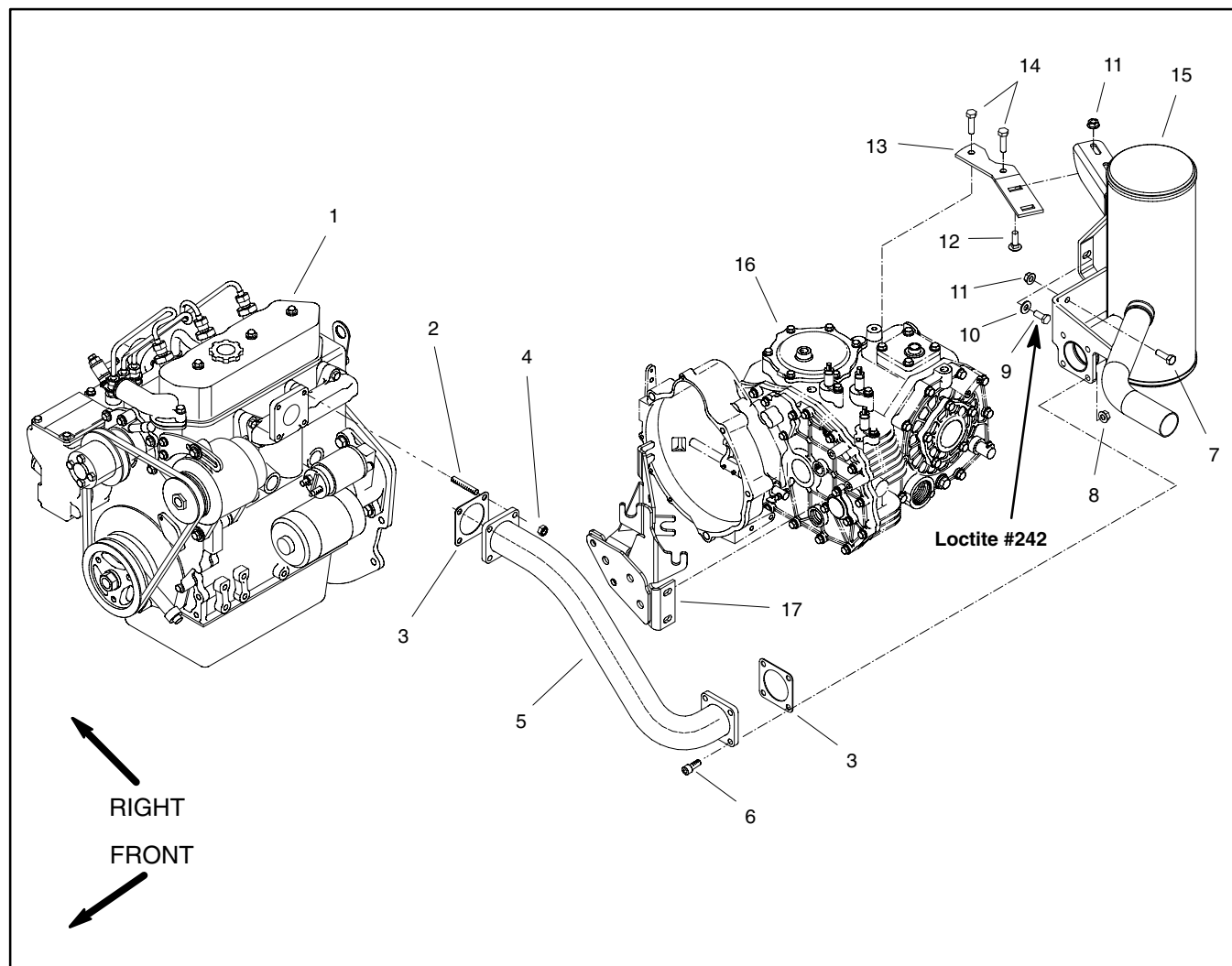


Figure 10

- | | | |
|-------------------------------|----------------------------|-------------------------------|
| 1. Engine | 7. Cap screw (2 used) | 13. Mount plate |
| 2. Stud (4 used) | 8. Flange nut (4 used) | 14. Cap screw |
| 3. Exhaust gasket | 9. Cap screw | 15. Muffler |
| 4. Hex nut (4 used) | 10. Hardened washer | 16. Transaxle |
| 5. Exhaust manifold | 11. Flange nut (4 used) | 17. Shift cable mount bracket |
| 6. Socket head screw (4 used) | 12. Carriage bolt (2 used) | |

Removal (Fig. 10)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.
2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Remove exhaust system components as needed using Figure 10 as a guide.
4. Discard gaskets and thoroughly clean flange surfaces of manifold and muffler.

Installation (Fig. 10)

1. Replace any removed gaskets.
2. If cap screw (item 9) was removed, apply Loctite #242 (or equivalent) to threads during installation.
3. Using Figure 10 as a guide, fit all exhaust components to vehicle before tightening any fasteners. When securing exhaust, tighten fasteners in the following order:
 - A. Hex nuts (item 4) that secure exhaust manifold to engine.
 - B. Cap screw (item 9) with washer (item 10) that secures muffler to transaxle.
 - C. Socket head screws (item 6) and flange nuts (item 8) that secure muffler to manifold.
 - D. Cap screws (item 7) and flange nuts (item 11) that secure muffler to shift cable mount bracket.
 - E. Carriage bolts (item 12) and flange nuts (item 11) that secure muffler to mount plate.
4. Lower or install bed or attachment(s).

Engine

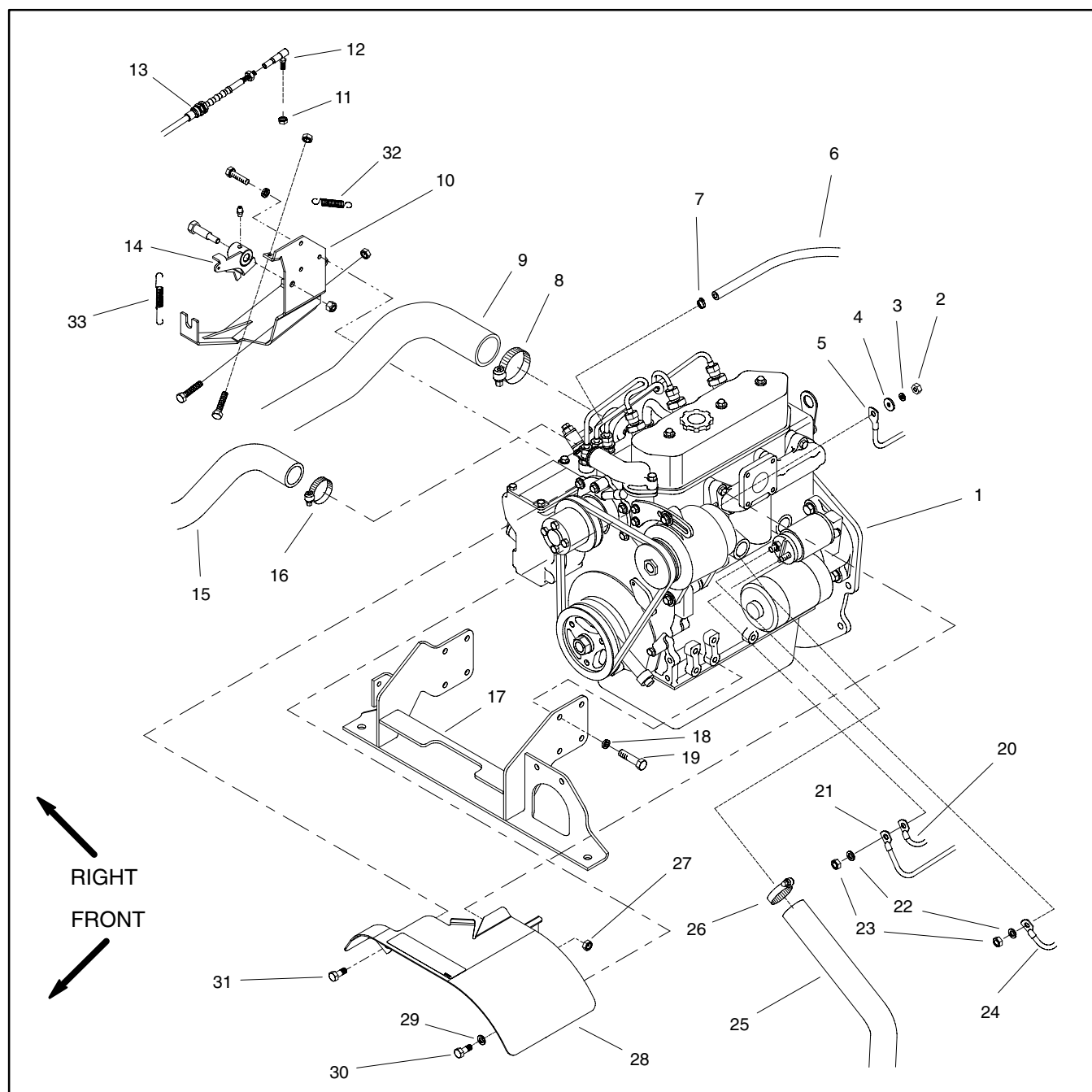


Figure 11

- | | | |
|---------------------------------|----------------------------|--------------------------------|
| 1. Engine | 12. Ball joint | 23. Hex nut |
| 2. Hex nut | 13. Accelerator cable | 24. Wire harness solenoid lead |
| 3. Lock washer | 14. Bellcrank | 25. Lower radiator hose |
| 4. Flat washer | 15. Upper radiator hose | 26. Hose clamp |
| 5. Wire harness alternator lead | 16. Hose clamp | 27. Hex nut |
| 6. Fuel hose | 17. Engine mount | 28. Engine cover |
| 7. Hose clamp | 18. Lock washer (8 used) | 29. Washer |
| 8. Hose clamp | 19. Cap screw (8 used) | 30. Cap screw |
| 9. Air intake hose | 20. Fusible link harness | 31. Cap screw |
| 10. Throttle bracket | 21. Positive battery cable | 32. Return spring |
| 11. Lock nut | 22. Lock washer | 33. Governor spring |

Engine Removal (Fig. 11)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.

2. Raise or remove the bed or other attachment(s) to gain access to engine. If bed is raised, place safety support on lift cylinder (see Operator's Manual).

3. Disconnect negative (–) and then positive (+) battery cables at the battery.

4. Remove exhaust manifold from vehicle (see Exhaust System Removal in this section).

5. Loosen hose clamp that secures air intake hose to carburetor. Remove intake hose from carburetor.

6. Disconnect fuel hose from carburetor on engine. Plug end of fuel hose to prevent contamination and fuel spillage. Position disconnected fuel hose away from engine.

7. Note location of cable ties used to secure wire leads. Label and disconnect electrical leads that attach to engine:

A. Battery cable and fusible link harness from starter solenoid stud.

B. Double wire from spade terminal on starter solenoid.

C. Wires from oil pressure switch, temperature sender (on water pump housing) and high temperature switch.

D. Harness connector and wire with ring terminal from alternator.

E. Wires from fuel solenoid and choke assembly on carburetor.

F. Six wires from ignition coils.

G. Two harness connectors from ignition controller.

H. Harness connector from crankshaft sensor.

8. Disconnect accelerator cable from bellcrank on engine. Position accelerator cable away from engine.

9. Drain coolant from radiator (see Operator's Manual). Loosen hose clamps and remove upper and lower radiator hoses from engine. Position hoses away from engine.

10. Remove four (4) cap screws (item 2) and lock nuts (item 5) that fasten both ends of hydraulic pump driveshaft to rubber couplers (Fig. 12). Locate and retrieve coupling spacers (item 3). Remove driveshaft.

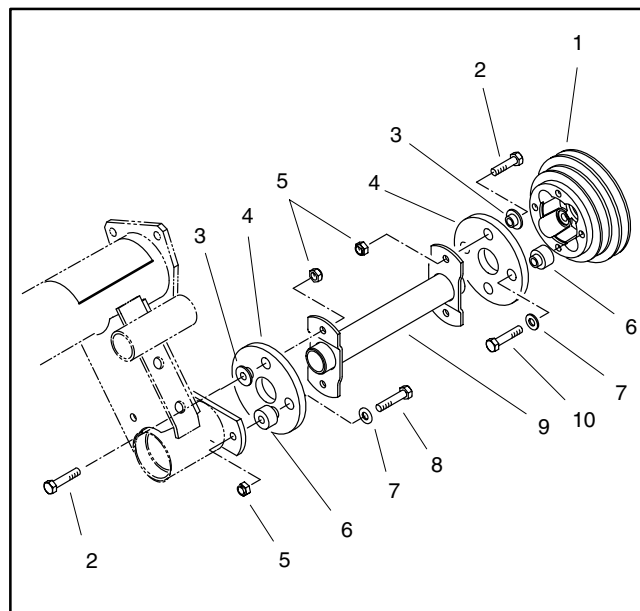


Figure 12

- | | |
|-----------------------------|-----------------------------|
| 1. Engine pulley | 6. Coupling spacer (4 used) |
| 2. Cap screw (4 used) | 7. Flat washer (4 used) |
| 3. Coupling spacer (4 used) | 8. Cap screw (2 used) |
| 4. Rubber coupling | 9. Hyd. pump driveshaft |
| 5. Lock nut (6 used) | 10. Cap screw (2 used) |

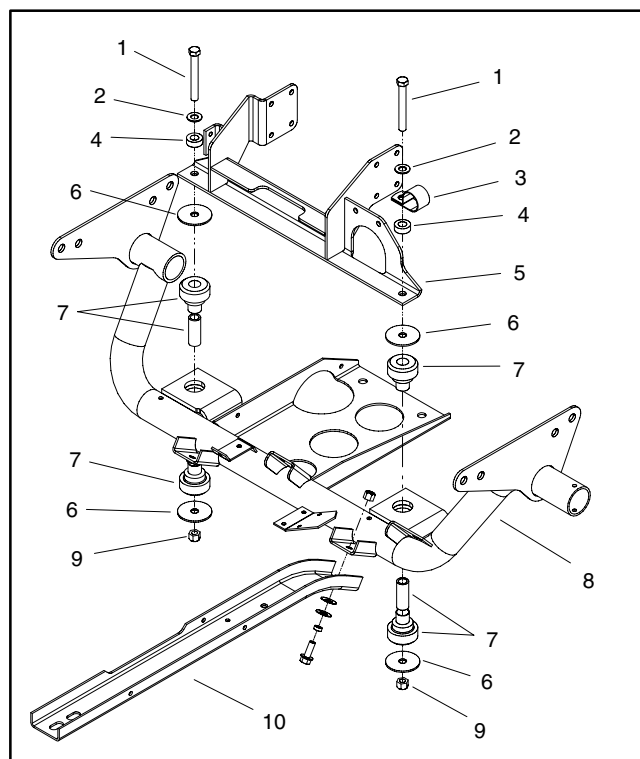


Figure 13

- | | |
|-----------------|--------------------|
| 1. Cap screw | 6. Snubbing washer |
| 2. Flat washer | 7. Engine mount |
| 3. R-clamp | 8. Engine support |
| 4. Spacer | 9. Lock nut |
| 5. Engine mount | 10. Guard (2 used) |

11. Remove any clamps and cable ties used to attach wiring harness, hoses or cables to the engine.

12. On 4WD vehicles, remove differential drive shaft (see Differential Driveshaft in the Service and Repairs section of Chapter 10 – Front Wheel Drive (4WD)).

13. Put blocking under transaxle for support.

14. Attach hoist or block and tackle to engine for support.

15. Loosen and remove two (2) locknuts (Item 9) and cap screws (Item 1) that secure engine mount to engine support (Fig. 13). Locate and retrieve flat washers (item 2), spacers (item 4) and snubbing washers (item 6).

16. Remove six (6) cap screws that secure clutch bell housing to engine. Note location of three (3) flat washers and three (3) harness brackets as caps screws are being removed (Fig. 14).

17. Use a hoist or block and tackle to remove engine from chassis. One person should operate hoist or block and tackle and the other person should help guide engine out of chassis. Move engine forward before lifting to disengage transaxle input shaft from clutch.

18. Note location and retrieve two (2) dowel pins from bell housing (Fig. 14).

19. If necessary, remove engine mount from engine.

20. If pressure plate and clutch disc removal is necessary, see Clutch Disassembly and Inspection in Chapter 6 – Drive Train.

Engine Installation (Fig. 11)

1. If pressure plate and clutch disc were removed, see Installing Clutch Disc and Cover in the Repairs section of Chapter 6 Drive Train.

2. If removed, secure engine mount to engine with eight (8) cap screws and lock washers.

3. To install the engine, perform Engine Removal steps in reverse order.

4. Install a new engine oil filter. Fill engine with the correct oil (see Operator's Manual).

5. Adjust accelerator cable (see Operator's Manual).

6. Check engine speed (both idle and high idle) and adjust if necessary (see Engine Speed Adjustment in Adjustments section of this chapter)

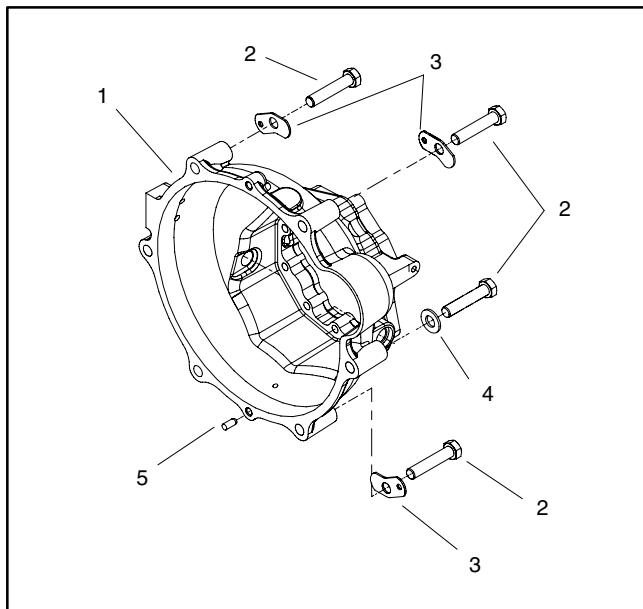


Figure 14

- | | |
|-----------------------|-------------------------|
| 1. Bell housing | 4. Flat washer (3 used) |
| 2. Cap screw (6 used) | 5. Dowel pins (2 used) |
| 3. Harness bracket | |

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Engine Throttle Bracket

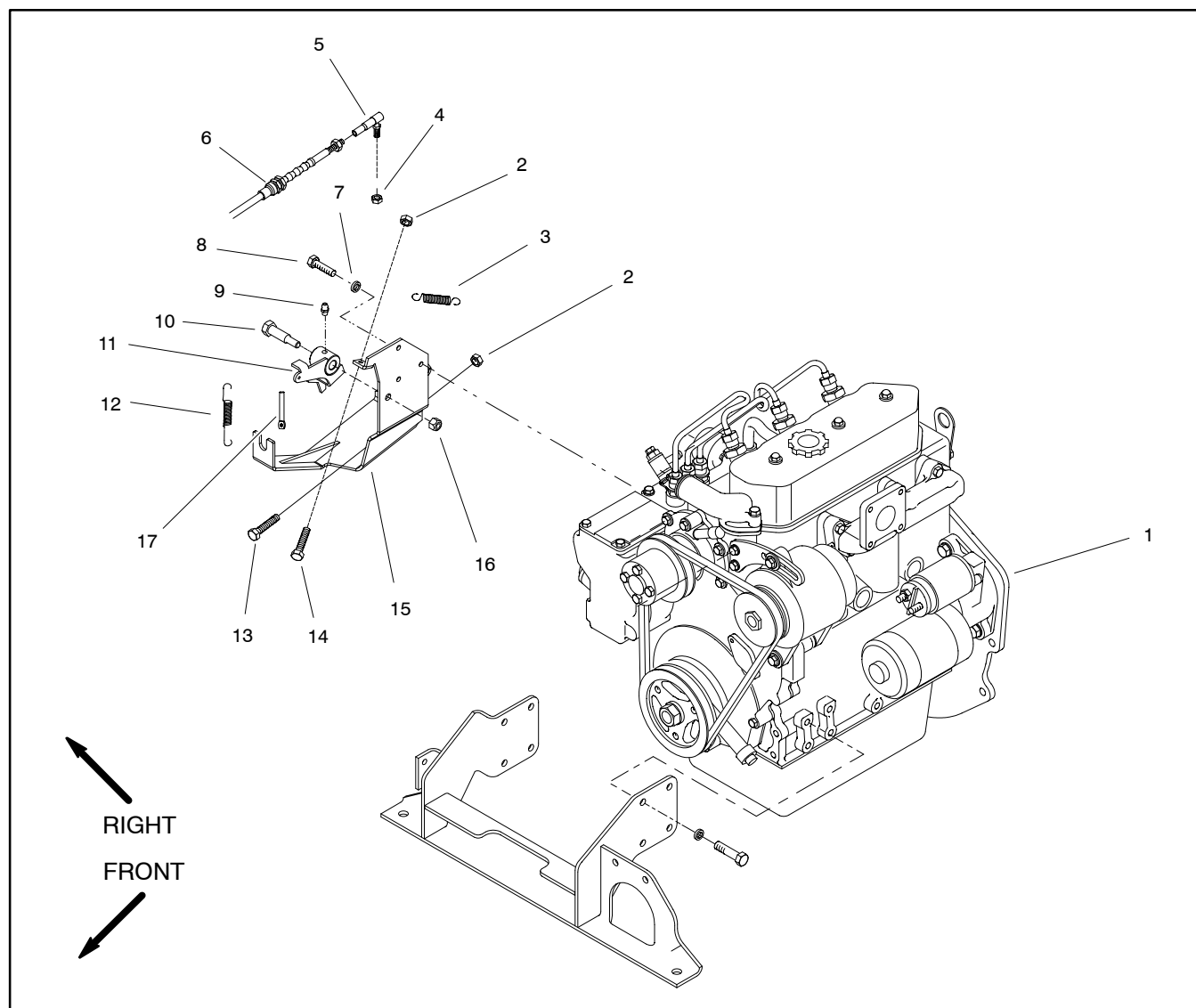


Figure 17

- | | | |
|----------------------|-------------------------------|--|
| 1. Engine | 7. Lock washer (3 used) | 13. Idle stop screw |
| 2. Jam nut | 8. Flange head screw (3 used) | 14. High idle stop screw |
| 3. Return spring | 9. Grease fitting | 15. Throttle bracket |
| 4. Lock nut | 10. Shoulder bolt | 16. Lock nut |
| 5. Ball joint | 11. Bellcrank | 17. Spring adjusting rod (if equipped) |
| 6. Accelerator cable | 12. Governor spring | |

Disassembly (Fig. 17)

1. Remove throttle bracket components from engine as needed using Figures 17, 18 and 19 as guides.

Assembly (Fig. 17)

1. Install removed throttle bracket components to engine using Figures 17, 18 and 19 as guides.

2. If removed, attach governor spring to bellcrank on throttle bracket and outer most slot in engine governor lever (Fig. 20).

3. Lubricate bellcrank grease fitting after assembly.

4. Check engine speed (both idle and high idle) and adjust if necessary (see Engine Speed Adjustment in Adjustments section of this chapter)

5. After engine speed has been checked and adjusted, check operation and adjustment of accelerator cable (see Operator's Manual). If needed, adjust accelerator cable.

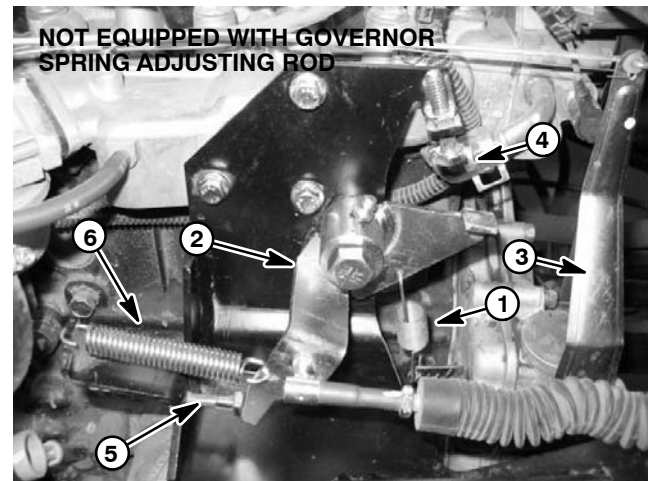


Figure 18

- | | |
|--------------------------|-------------------------|
| 1. Governor spring | 4. High idle stop screw |
| 2. Bellcrank | 5. Low idle stop screw |
| 3. Engine governor lever | 6. Return spring |

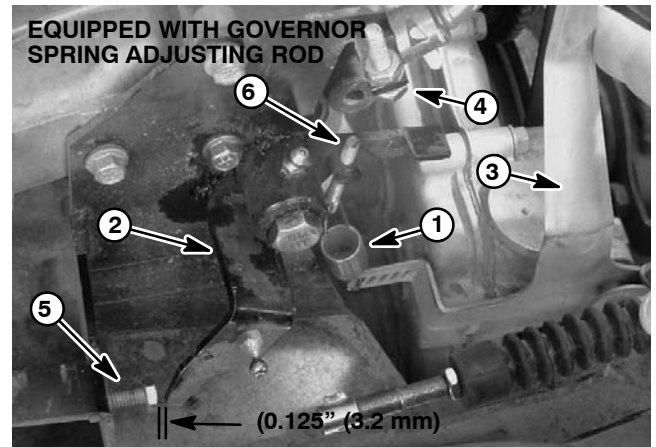


Figure 19

- | | |
|--------------------------|-------------------------|
| 1. Governor spring | 4. High idle stop screw |
| 2. Bellcrank | 5. Low idle stop screw |
| 3. Engine governor lever | 6. Spring adjusting rod |

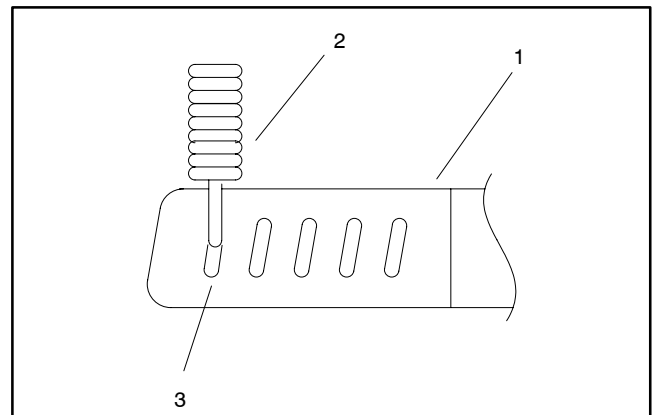


Figure 20

- | | |
|--------------------------|-------------------------|
| 1. Engine governor lever | 3. Spring mounting slot |
| 2. Governor spring | |

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Briggs/Daihatsu Diesel Engine

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BRIGGS & STRATTON/DAIHATSU REPAIR MANUAL FOR 3-CYLINDER, LIQUID-COOLED, DIESEL EN- GINES	

Introduction

This Chapter gives information about specifications and repair of the Briggs and Stratton/Daihatsu 3LC diesel engine used in the Workman 3300-D and 4300-D.

General engine maintenance procedures are described in your Operator's Manual. Information on engine troubleshooting, testing, disassembly, and reassembly is identified in the Briggs & Stratton/Daihatsu Repair Manual that is included at the end of this section.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Briggs & Stratton/Daihatsu Repair Manual. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Briggs and Stratton/Daihatsu 3LC diesel engines are supplied through your local Toro distributor.

Specifications

Item	Description
Make / Designation	Briggs & Stratton/Daihatsu, 4–stroke, Liquid Cooled, OHV Diesel
Number of Cylinders	3
Bore x Stroke mm (in.)	72 x 78 (2.834 x 3.07)
Total Displacement cc (cu. in.)	952 (58.1)
Compression Ratio	24.0:1
Firing Order	1 (front) – 2 – 3
Dry Weight (approximate) kg (lb.)	78 (172)
Fuel	Grade No. 2–D or 1–D automotive type diesel fuel
Fuel Injection Pump	Bosch VE (Distributor type)
Fuel Injector Nozzle	Bosch throttle type
Fuel Tank Capacity liter (U.S. gal.)	26 (7)
Governor	Mechanical
Idle Speed (no load)	1500 ± 50 RPM
High Idle (no load)	3600 ± 50 RPM
Engine Oil	API Classification CF or better (see Operator's Manual for viscosity)
Oil Pump	Gear driven trochoid type
Crankcase Oil Capacity liter (U.S. qt.)	3.3 (3.5) with filter
Water Pump	Belt driven centrifugal type
Cooling System Capacity liter (U.S. qt.)	3.8 (4.0)
Starter	12 VDC 1.2 KW
Alternator/Regulator	12 VDC 40 AMP

General Information

Adding Oil to Engine

When adding oil to the engine, maintain clearance between the oil fill device and the oil fill opening in the valve cover (Fig. 1). This clearance is necessary to allow venting when adding engine oil which will prevent oil from running into the breather tube and intake system.

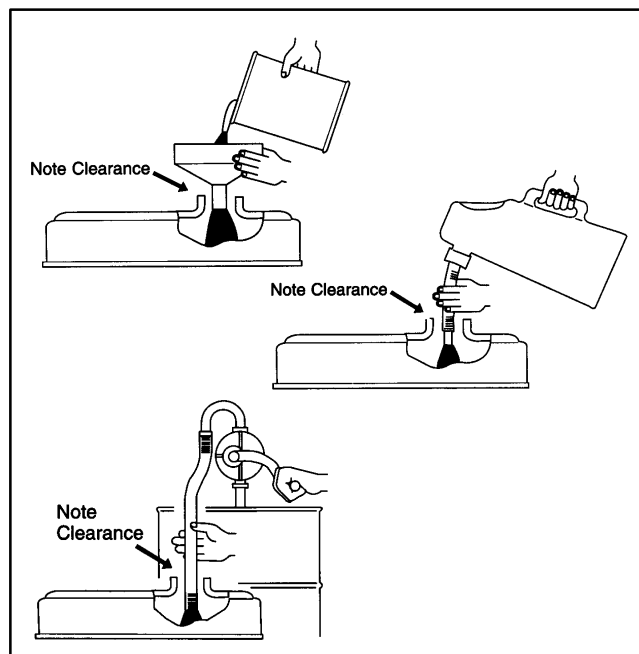


Figure 1

Adjustments

Adjust Engine Speed

1. Park vehicle on a level surface, engage parking brake and place gear shift lever in neutral.
2. Raise the bed or remove attachment(s) to allow access to engine. If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Allow engine to reach operating temperature before checking or adjusting engine speed.
4. With engine running at idle speed, use a tachometer to check that engine is operating at **1500 \pm 50 RPM**.
5. If idle speed is incorrect, adjust idle speed screw (Fig. 2).
 - A. Loosen lock nut on idle speed screw.
 - B. Adjust idle speed screw to obtain **1500 \pm 50 RPM**.
 - C. Tighten lock nut. Recheck idle speed.
6. Increase engine speed to high idle. Use a tachometer to check that engine is operating at **3600 \pm 50 RPM**.
7. If high idle speed is incorrect, adjust high speed screw on fuel injection pump (Fig. 3).
 - A. Loosen lock nut on high speed screw.
 - B. Adjust high speed screw to obtain **3600 \pm 50 RPM**.
 - C. Tighten lock nut. Recheck high idle speed.

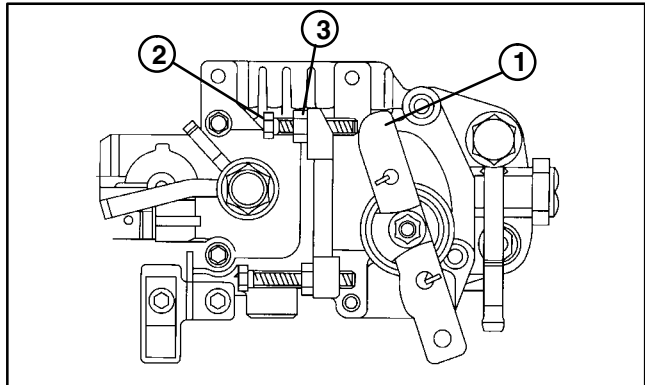


Figure 2

- | | |
|------------------------|-------------|
| 1. Speed control lever | 3. Lock nut |
| 2. Idle speed screw | |

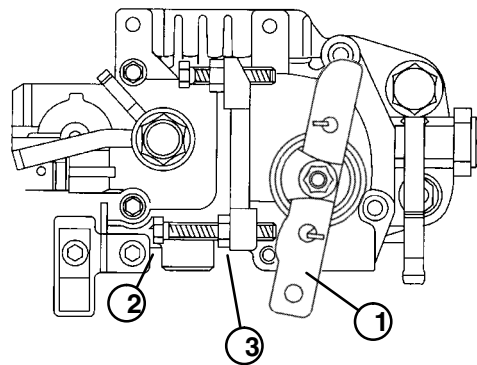


Figure 3

- | | |
|------------------------|-------------|
| 1. Speed control lever | 3. Lock nut |
| 2. High speed screw | |

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Service and Repairs

Radiator

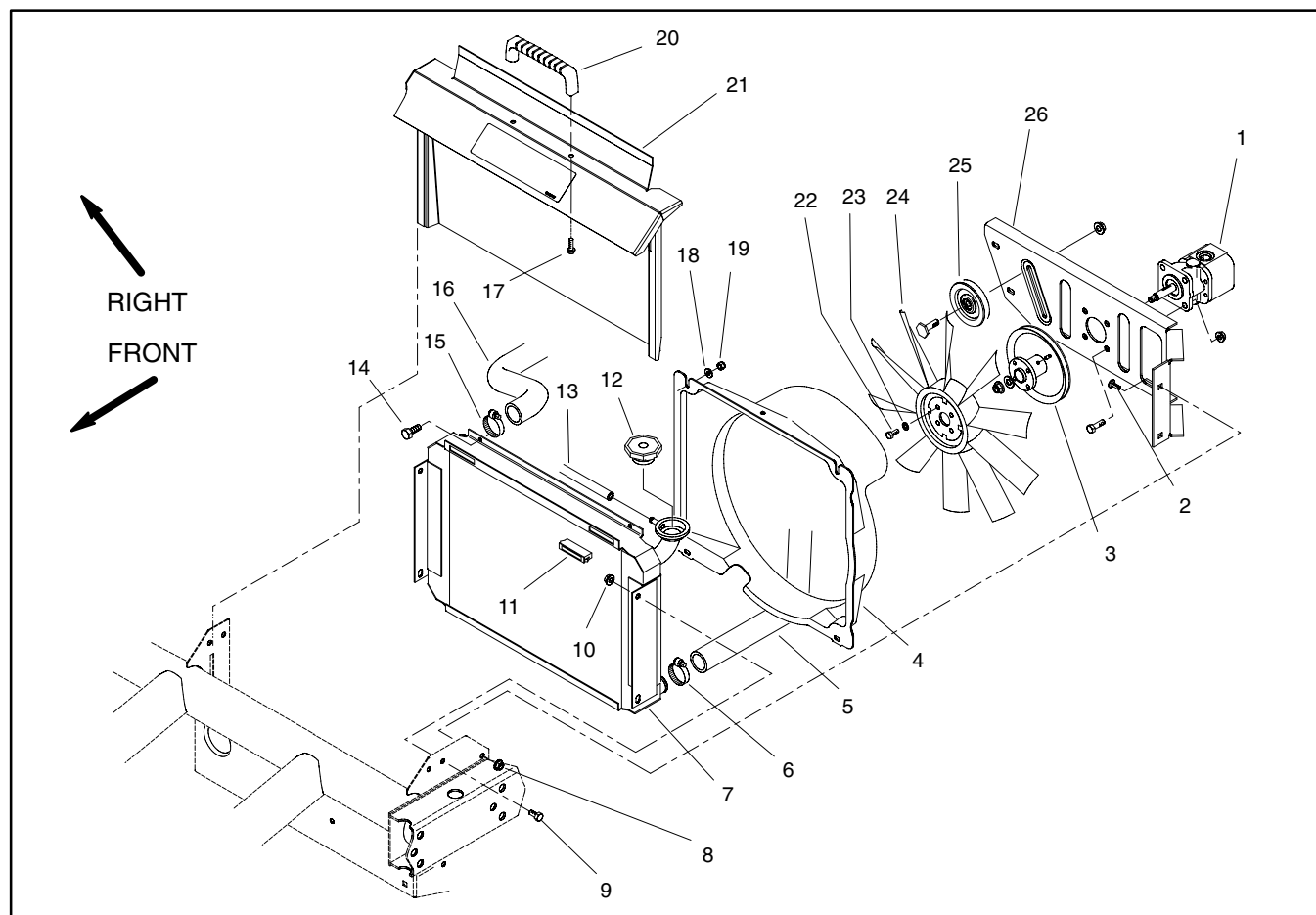
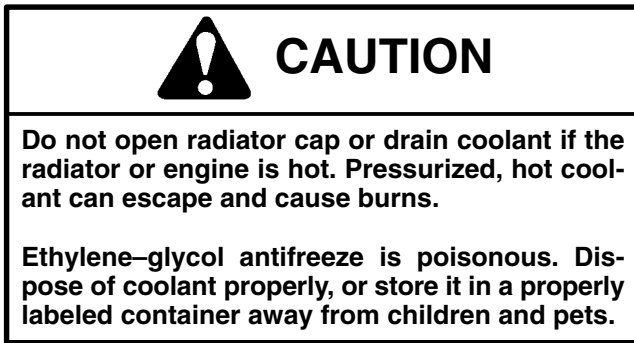


Figure 4

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|----------------------------|---------------------------------|---------------------------|
| 1. Hydraulic pump | 10. Flange nut (4 used) | 19. Lock nut (4 used) |
| 2. Carriage screw (4 used) | 11. Magnetic catch (2 used) | 20. Handle |
| 3. Fan hub/pulley | 12. Radiator cap | 21. Radiator cover/screen |
| 4. Fan shroud | 13. Hose (to coolant reservoir) | 22. Cap screw (4 used) |
| 5. Lower radiator hose | 14. Cap screw (4 used) | 23. Lock washer (4 used) |
| 6. Hose clamp | 15. Hose clamp | 24. Fan |
| 7. Radiator | 16. Upper radiator hose | 25. Idler pulley |
| 8. Lock nut (4 used) | 17. Screw (2 used) | 26. Mount plate |
| 9. Cap screw (4 used) | 18. Flat washer | |

Removal (Fig. 4)

1. Park vehicle on a level surface, stop engine, engage parking brake, and remove key from the ignition switch. Allow engine to cool.
2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Lift and remove the radiator screen from front of radiator.



4. Remove the radiator cap. Drain radiator into a suitable container using the radiator drain located on the lower right corner of the radiator.
5. Disconnect upper and lower radiator hoses from the radiator.
6. Disconnect reservoir hose (item 13) from the radiator filler neck.
7. Detach fan shroud from the radiator by removing four (4) cap screws, flat washers and lock nuts. Position shroud away from radiator.
8. Remove four (4) cap screws and flange nuts that secure the radiator to the frame. Pull radiator from the vehicle.
9. Plug all radiator and hose openings to prevent contamination.

Installation (Fig. 4)

1. Remove plugs from radiator and hoses placed during the removal procedure.
2. Position radiator to the frame. Secure radiator to the vehicle with four (4) cap screws and flange nuts.
3. Attach fan shroud to the radiator with four (4) cap screws, flat washers and lock nuts. Make sure that clearance exists between shroud and fan at all points.
4. Connect reservoir hose (item 11) to the radiator filler neck.
5. Connect upper and lower hoses to the radiator.
6. Make sure radiator drain is closed. Fill radiator with coolant (see Operator's Manual).
7. Install the radiator screen.
8. Lower or install bed or other attachment(s).

Pump Driveshaft Service

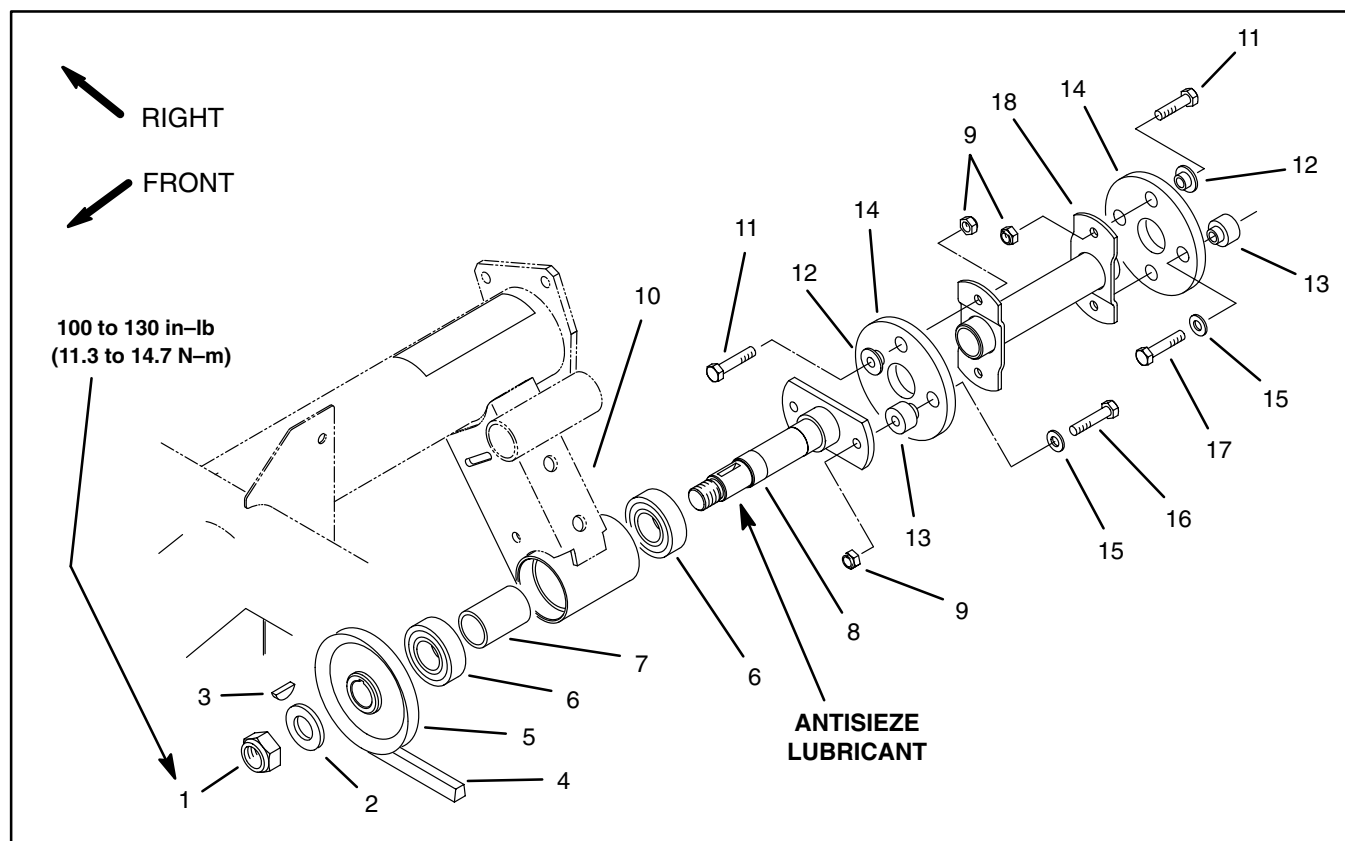


Figure 5

1. Lock nut
2. Flat washer
3. Woodruff key
4. Pump drive belt
5. Pulley
6. Bearing

7. Bearing spacer
8. Shaft
9. Lock nut (6 used)
10. Frame support bracket
11. Cap screw (4 used)
12. Coupling spacer (4 used)

13. Coupling spacer (4 used)
14. Rubber coupling
15. Flat washer (4 used)
16. Cap screw (2 used)
17. Cap screw (2 used)
18. Driveshaft

Removal (Fig. 5)

1. Park vehicle on a level surface, raise and support bed (if installed), shut engine off and engage the parking brake.
2. Disassemble driveshaft using Figure 5 as a guide.
3. Do not reuse bearings (Item 6) if they have been removed from frame support bracket. Replace with new bearings.

Inspection

1. Inspect frame support bracket for wear or damage.
2. Inspect bearing spacer (Item 7) for wear or damage. Also, check that spacer length is from 1.884" to 1.894" (47.85 to 48.10 mm). Replace spacer if necessary.

Installation (Fig. 5)

1. To install bearings (Item 6) into frame support bracket:
 - A. Install pulley side bearing into support bracket by pressing on bearing outer race until bearing contacts shoulder in support bracket.
 - B. Place the bearing spacer (Item 7) into bracket cavity.
 - C. Install second bearing into bracket by pressing on the bearing outer race until bearing inner race contacts spacer.
2. Slide shaft (Item 8) into installed bearings in frame support bracket. Apply antisieze lubricant to pulley end of shaft before installing woodruff key (Item 3) and pulley (Item 5).
3. Secure pulley to shaft with washer and lock nut. Torque lock nut from 100 to 130 in-lb (11.3 to 14.7 N-m). Make sure that shaft rotates freely after pulley is installed.
4. Assemble driveshaft using Figure 5 as a guide.
5. Adjust pump drive belt tension after assembly (see Operator's Manual).

Fuel Tank

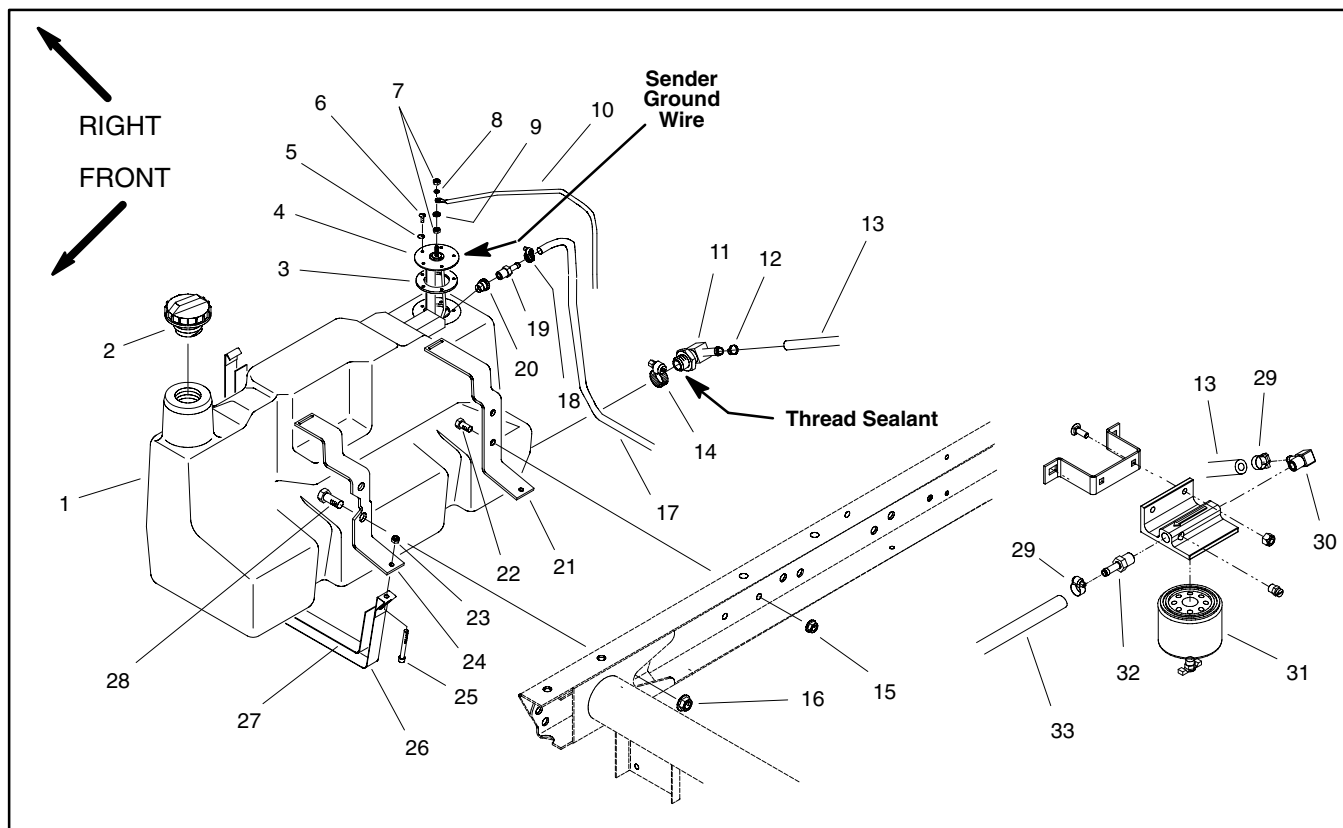


Figure 6

- | | | |
|-------------------------|------------------------------------|---------------------------------|
| 1. Fuel tank | 12. Hose clamp | 23. Lock nut (2 used) |
| 2. Fuel tank cap | 13. Fuel hose (to fuel filter) | 24. Front fuel tank support |
| 3. Gasket | 14. Clamp | 25. Socket head screw (2 used) |
| 4. Fuel sender | 15. Flange nut (2 used) | 26. Fuel tank strap (2 used) |
| 5. Lock washer (5 used) | 16. Flange nut (2 used) | 27. Felt strap (2 used) |
| 6. Screw (5 used) | 17. Fuel hose (return from engine) | 28. Cap screw (2 used) |
| 7. Hex nut | 18. Hose clamp | 29. Hose clamp |
| 8. Lock washer | 19. Fitting | 30. Fitting |
| 9. Spacer | 20. Bushing | 31. Fuel filter/water separator |
| 10. Wire harness lead | 21. Rear fuel tank support | 32. Fitting |
| 11. Fuel fitting | 22. Cap screw (2 used) | 33. Fuel hose (to engine) |



DANGER

Because diesel fuel is highly flammable, use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running, hot, or when vehicle is in an enclosed area. Always fill fuel tank outside and wipe up any spilled fuel before starting the engine. Store fuel in a clean, safety-approved container and keep cap in place. Use fuel for the engine only; not for any other purpose.

Check Fuel Lines and Connections

Check fuel lines and connections periodically as recommended in the Operator's Manual. Check lines for deterioration, damage, leaks, or loose connections. Replace hoses, clamps, and connections as necessary.

Fuel Tank Removal (Fig. 6)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.
2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Disconnect negative battery cable first and then positive battery cable. Remove battery from vehicle (see Operator's Manual).

IMPORTANT: Review safety information regarding fuel handling in the Operator's Manual and Chapter 2 – Safety.

4. Loosen hose clamp and disconnect fuel hose (item 13) from fuel filter located on right side frame rail. Drain fuel from the fuel tank into a suitable container.
 5. Loosen hose clamp and remove return hose (item 17) from fitting on top of tank.
- NOTE:** To prevent fuel leakage, do not loosen lower nut on fuel sender stud.
6. Disconnect electrical wiring from the fuel sender on the fuel tank.
 7. Loosen socket head screws (item 25) and lock nuts (item 23) to allow tank straps to be unhooked from fuel tank supports.
 8. Remove fuel tank from vehicle.

Fuel Tank Installation (Fig. 6)

1. Check felt straps (item 27) and replace if worn or damaged.

IMPORTANT: When positioning fuel tank to vehicle, make sure that hydraulic lift cylinder does not contact tank.

2. Position fuel tank to tank straps and fuel tank supports. Hook tank straps to fuel tank supports. Tighten socket head screws and lock nuts to secure fuel tank.
3. If fuel fitting was removed from tank, apply thread sealant to threads of fitting before installing fitting into tank.
4. Connect electrical wiring to the fuel sender.
 - A. Connect blue/white wire with ring terminal to the center fuel sender terminal and secure with lock washer and hex nut.
 - B. Connect black (ground) wire with the screw (item 6) that is closest to the frame rail.
 - C. Apply skin-over grease to the wire terminal connections and cover center terminal with harness boot.
5. Connect return hose to fitting on top of tank and secure with clamp.
6. Connect fuel hose from tank outlet to fuel filter and secure with clamp.



CAUTION

Connecting battery cables to the wrong battery post could result in personal injury and/or damage to the electrical system.

7. Position battery in vehicle (see Operator's Manual). Connect positive battery cable first and then negative battery cable.
8. Lower or install the bed or other attachment(s).
9. Fill fuel tank (see Operator's Manual). Check for fuel leakage and correct if found.

Air Cleaner System

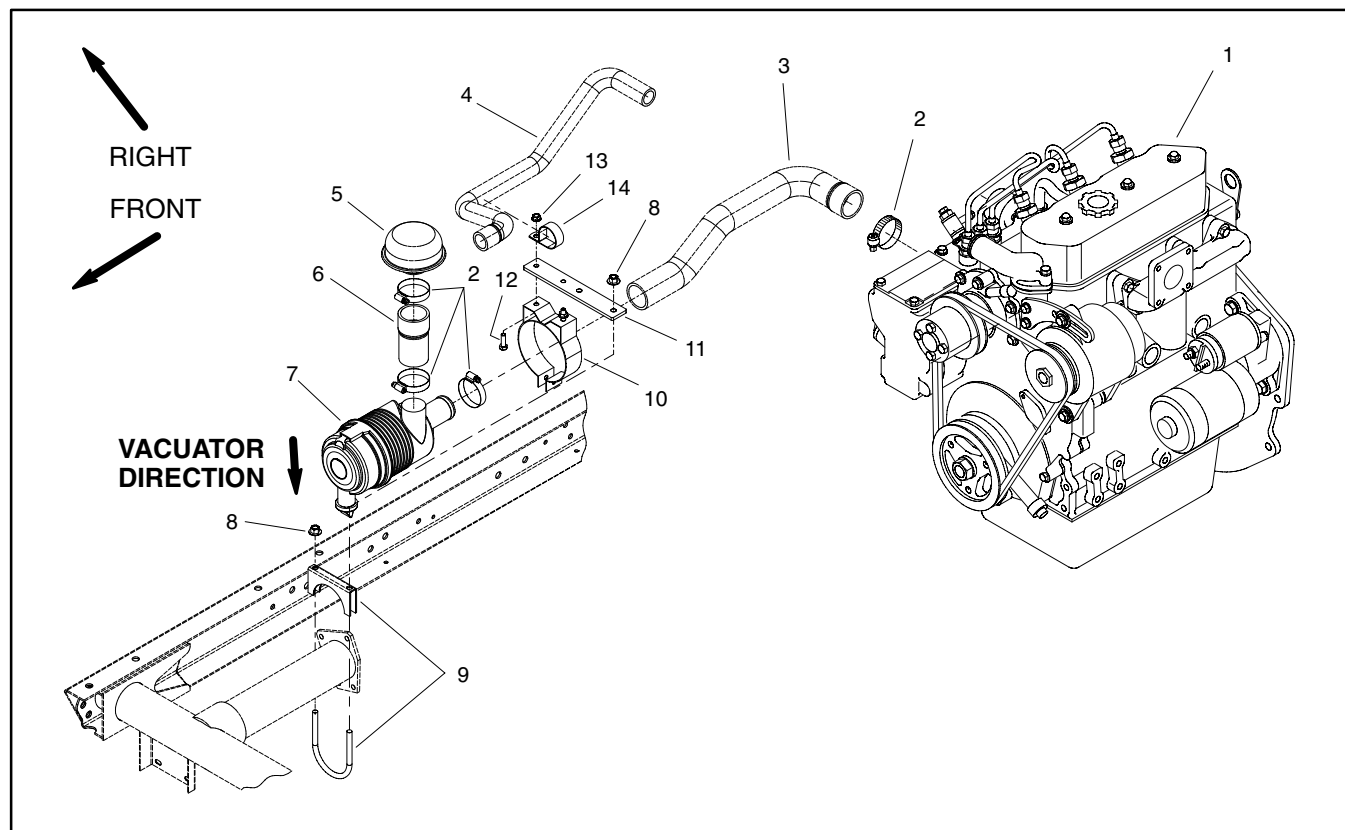


Figure 7

- | | | |
|--------------------|-------------------------|-------------------------|
| 1. Engine | 6. Air cleaner hose | 11. Mount bracket |
| 2. Hose clamp | 7. Air cleaner assembly | 12. Cap screw (2 used) |
| 3. Air intake hose | 8. Flange nut (2 used) | 13. Flange nut (2 used) |
| 4. Radiator hose | 9. Clamp | 14. R-clamp |
| 5. Air inlet hood | 10. Mounting band | |

Removal (Fig. 7)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.
2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Remove air cleaner components as needed using Figure 7 and 8 as guides.

Installation (Fig. 7)

IMPORTANT: Any leaks in the air filter system will cause serious engine damage. Make sure daily that all air cleaner components are in good condition and are properly secured during reassembly.

1. Reassemble air cleaner system using Figure 7 and 8 as guides. Air cleaner hose (item 6) and air inlet hood (item 5) should be positioned straight upward. The vacuator valve on the air cleaner assembly should be positioned downward.
2. Lower or install bed or attachment(s).

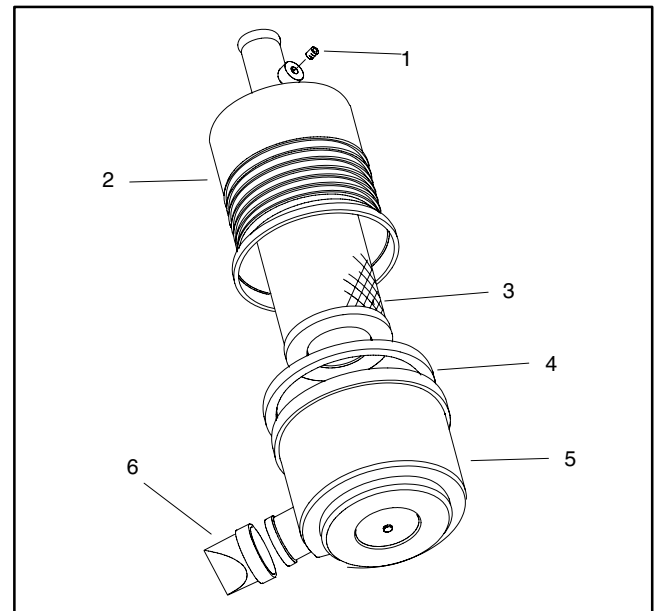


Figure 8

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|------------------|-------------------|
| 1. Plug | 4. Gasket |
| 2. Upper housing | 5. Lower housing |
| 3. Element | 6. Vacuator valve |

Exhaust System

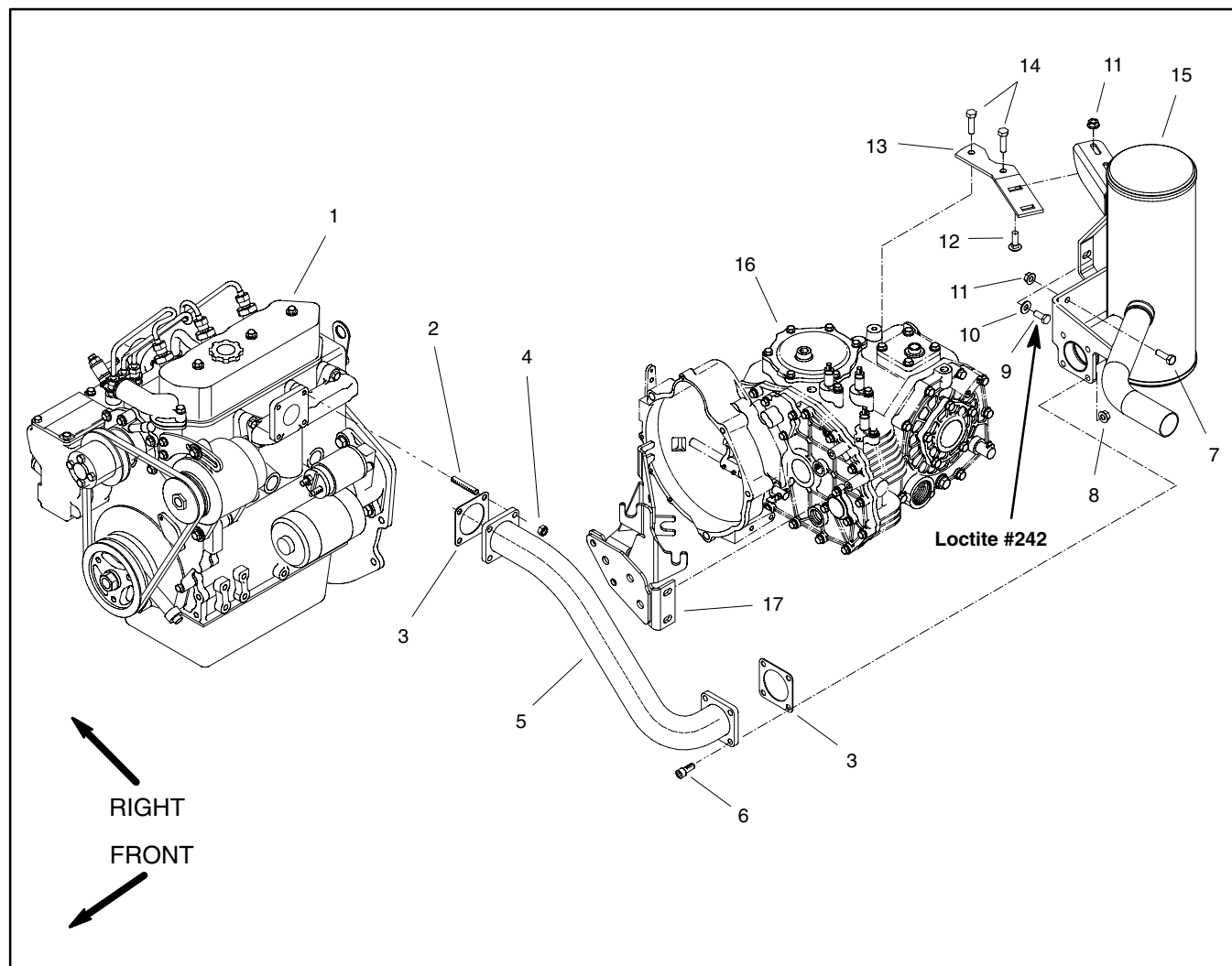


Figure 9

- | | | |
|-------------------------------|----------------------------|-------------------------------|
| 1. Engine | 7. Cap screw (2 used) | 13. Mount plate |
| 2. Stud (4 used) | 8. Flange nut (4 used) | 14. Cap screw |
| 3. Exhaust gasket | 9. Cap screw | 15. Muffler |
| 4. Hex nut (4 used) | 10. Hardened washer | 16. Transaxle |
| 5. Exhaust manifold | 11. Flange nut (4 used) | 17. Shift cable mount bracket |
| 6. Socket head screw (4 used) | 12. Carriage bolt (2 used) | |

Removal (Fig. 10)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.
2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Remove exhaust system components as needed using Figure 10 as a guide.
4. Discard gaskets and thoroughly clean flange surfaces of manifold and muffler.

Installation (Fig. 10)

1. Replace any removed gaskets.
2. If cap screw (item 9) was removed, apply Loctite #242 (or equivalent) to threads during installation.
3. Using Figure 10 as a guide, fit all exhaust components to vehicle before tightening any fasteners. When securing exhaust, tighten fasteners in the following order:
 - A. Hex nuts (item 4) that secure exhaust manifold to engine.
 - B. Cap screw (item 9) with washer (item 10) that secures muffler to transaxle.
 - C. Socket head screws (item 6) and flange nuts (item 8) that secure muffler to manifold.
 - D. Cap screws (item 7) and flange nuts (item 11) that secure muffler to shift cable mount bracket.
 - E. Carriage bolts (item 12) and flange nuts (item 11) that secure muffler to mount plate.
4. Lower or install bed or attachment(s).

Engine

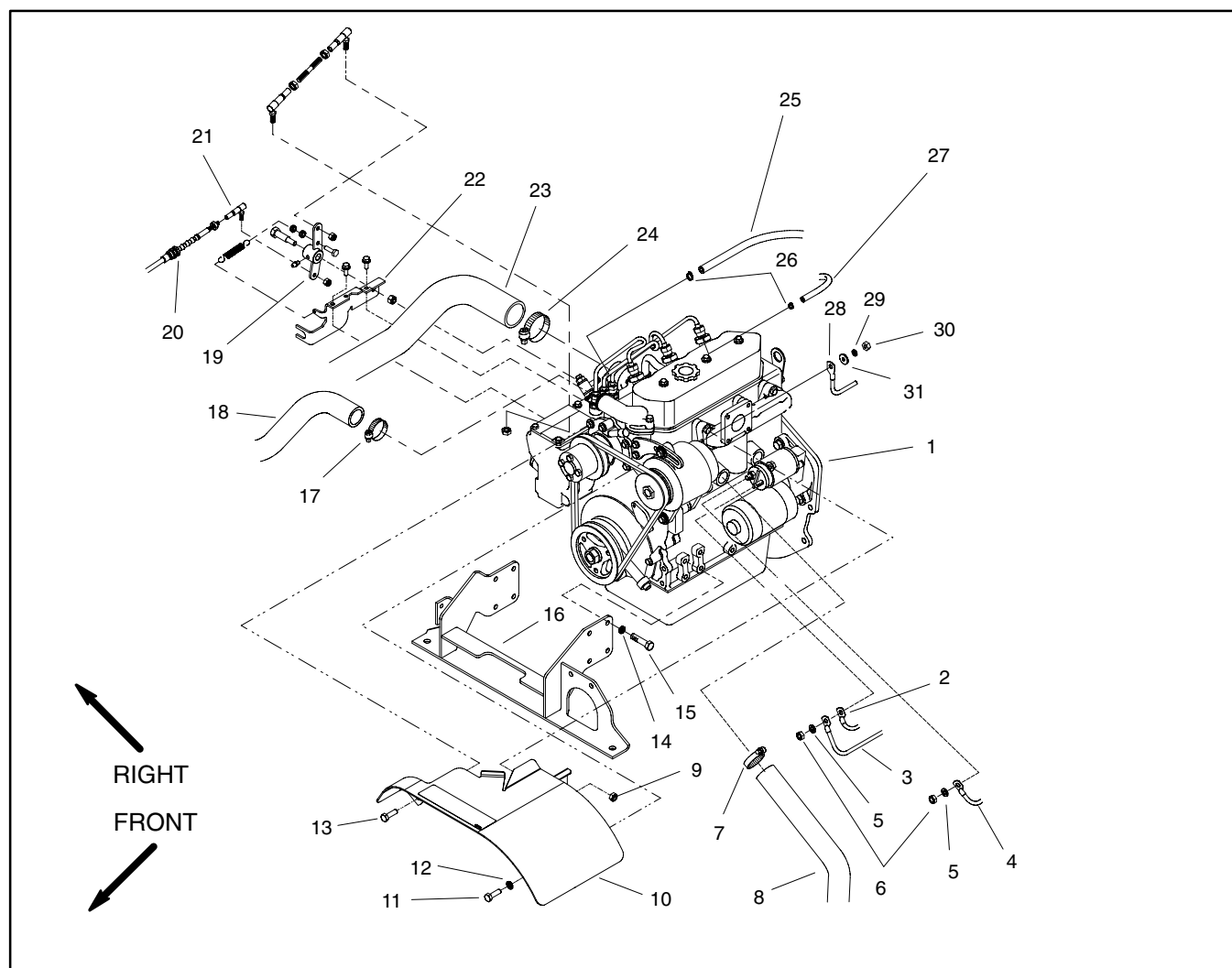


Figure 10

- | | | |
|-------------------------------|--------------------------|----------------------------------|
| 1. Engine | 12. Washer | 22. Throttle bracket |
| 2. Fusible link harness | 13. Cap screw | 23. Air intake hose |
| 3. Positive battery cable | 14. Lock washer (8 used) | 24. Hose clamp |
| 4. Wire harness solenoid lead | 15. Cap screw (8 used) | 25. Fuel supply hose |
| 5. Lock washer | 16. Engine mount | 26. Hose clamp |
| 6. Hex nut | 17. Hose clamp | 27. Fuel hose (return) |
| 7. Hose clamp | 18. Upper radiator hose | 28. Wire harness alternator lead |
| 8. Lower radiator hose | 19. Throttle bellcrank | 29. Lock washer |
| 9. Hex nut | 20. Accelerator cable | 30. Hex nut |
| 10. Engine cover | 21. Ball joint | 31. Flat washer |
| 11. Cap screw | | |

Engine Removal (Fig. 10)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.

2. Raise or remove the bed or other attachment(s) to gain access to engine. If bed is raised, place safety support on lift cylinder (see Operator's Manual).

3. Disconnect negative (–) and then positive (+) battery cables at the battery.

4. Remove exhaust manifold from vehicle (see Exhaust System Removal in this section).

5. Loosen hose clamp that secures air intake hose to engine. Remove intake hose from engine.

6. Disconnect fuel hose from fuel injection pump on engine. Plug end of fuel hose to prevent contamination and fuel spillage. Position disconnected fuel hose away from engine.

7. Note location of cable ties used to secure wire leads. Label and disconnect electrical leads that attach to engine:

A. Battery cable and fusible link harness from starter solenoid stud.

B. Double wire from spade terminal on starter solenoid.

C. Wires from oil pressure switch, temperature sender on water pump housing and high temperature switch.

D. Harness connector and wire with ring terminal from alternator.

E. Harness connector with ring terminal from glow plug connector.

F. Harness connector from fuel solenoid on injection pump.

G. Harness connector from crankshaft sensor.

8. Disconnect accelerator cable from throttle lever on engine. Position accelerator cable away from engine.

9. Drain coolant from radiator (see Operator's Manual). Loosen hose clamps and remove upper and lower radiator hoses from engine. Position hoses away from engine.

10. Remove four (4) cap screws (item 2) and lock nuts (item 5) that fasten both ends of hydraulic pump driveshaft to rubber couplers (Fig. 11). Locate and retrieve coupling spacers (item 3). Remove driveshaft.

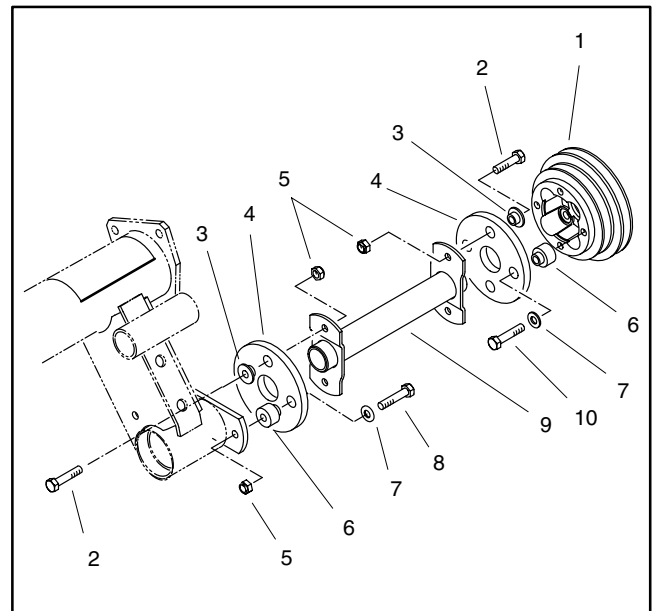


Figure 11

- | | |
|-----------------------------|-----------------------------|
| 1. Engine pulley | 6. Coupling spacer (4 used) |
| 2. Cap screw (4 used) | 7. Flat washer (4 used) |
| 3. Coupling spacer (4 used) | 8. Cap screw (2 used) |
| 4. Rubber coupling | 9. Hyd. pump driveshaft |
| 5. Lock nut (6 used) | 10. Cap screw (2 used) |

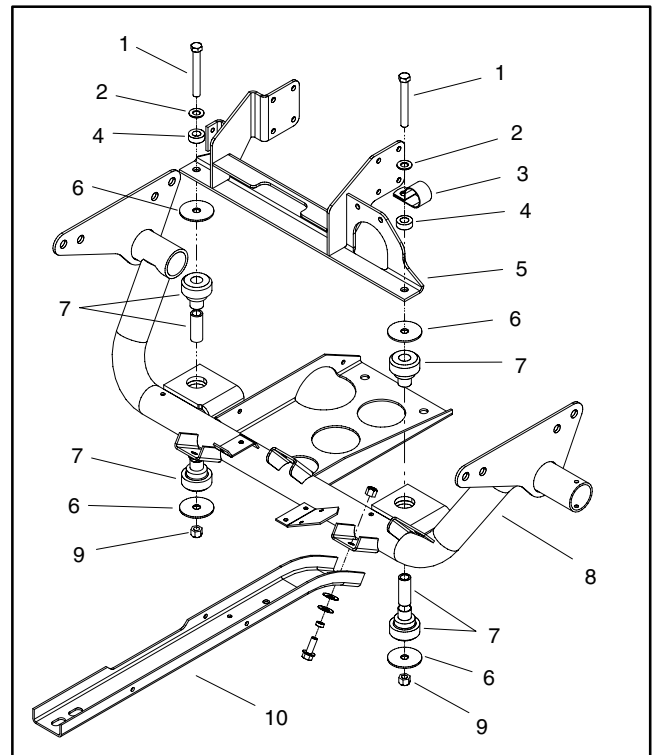


Figure 12

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|-----------------|--------------------|
| 1. Cap screw | 6. Snubbing washer |
| 2. Flat washer | 7. Engine mount |
| 3. R-clamp | 8. Engine support |
| 4. Spacer | 9. Lock nut |
| 5. Engine mount | 10. Guard (2 used) |

11. Remove any clamps and cable ties used to attach wiring harness, hoses or cables to the engine.

12. On 4WD vehicles, remove differential drive shaft (see Differential Driveshaft in the Service and Repairs section of Chapter 10 – Front Wheel Drive (4WD)).

13. Put blocking under transaxle for support.

14. Attach hoist or block and tackle to engine for support.

15. Loosen and remove two (2) locknuts (Item 9) and cap screws (Item 1) that secure engine mount to engine support (Fig. 13). Locate and retrieve flat washers (item 2), spacers (item 4) and snubbing washers (item 6).

16. Remove six (6) cap screws that secure clutch bell housing to engine. Note location of three (3) flat washers and three (3) harness brackets as caps screws are being removed (Fig. 13).

17. Use a hoist or block and tackle to remove engine from chassis. One person should operate hoist or block and tackle and the other person should help guide engine out of chassis. Move engine forward before lifting to disengage transaxle input shaft from clutch.

18. Note location and retrieve two (2) dowel pins from bell housing (Fig. 13).

19. If necessary, remove engine mount from engine.

20. If pressure plate and clutch disc removal is necessary, see Clutch Disassembly and Inspection in Chapter 6 – Drive Train.

Engine Installation (Fig. 10)

1. If pressure plate and clutch disc were removed, see Installing Clutch Disc and Cover in the Repairs section of Chapter 6 Drive Train.

2. If removed, secure engine mount to engine with eight (8) cap screws and lock washers.

3. To install the engine, perform Engine Removal steps in reverse order.

4. Install a new engine oil filter. Fill engine with the correct oil (see Operator's Manual).

5. Adjust accelerator cable (see Operator's Manual).

6. Check engine speed (both idle and high idle) and adjust if necessary (see Adjust Engine Speed in Adjustments section of this chapter)

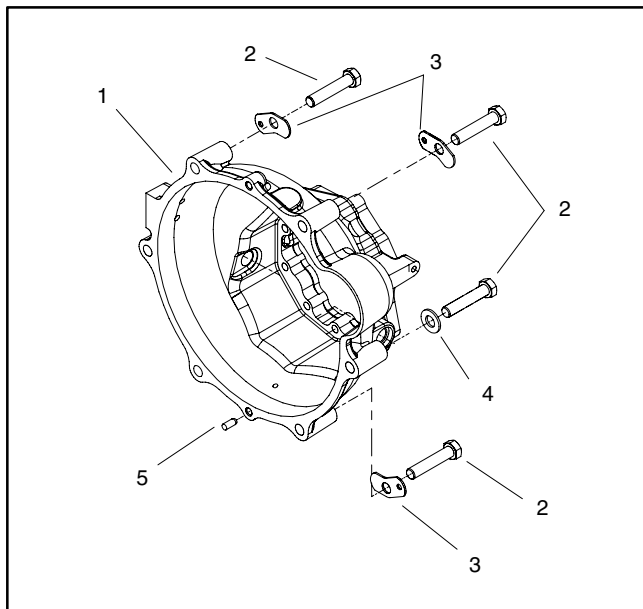


Figure 13

- | | |
|-----------------------|-------------------------|
| 1. Bell housing | 4. Flat washer (3 used) |
| 2. Cap screw (6 used) | 5. Dowel pins (2 used) |
| 3. Harness bracket | |

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Engine Throttle Bracket

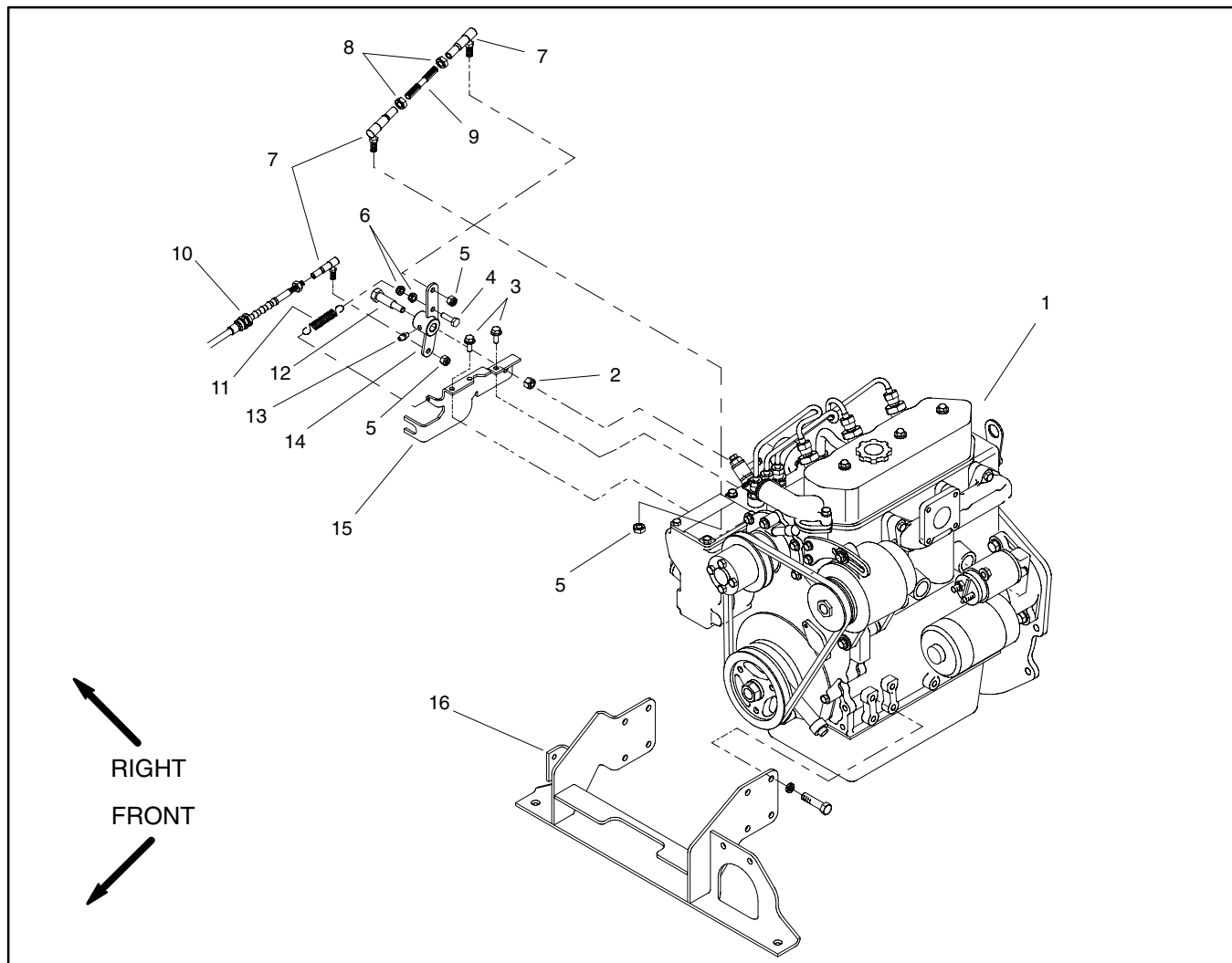


Figure 14

- | | | |
|--------------|-----------------------|------------------------|
| 1. Engine | 7. Ball joint | 12. Shoulder bolt |
| 2. Lock nut | 8. Jam nut | 13. Grease fitting |
| 3. Cap screw | 9. Threaded rod | 14. Throttle bellcrank |
| 4. Cap screw | 10. Accelerator cable | 15. Throttle bracket |
| 5. Lock nut | 11. Return spring | 16. Engine mount |
| 6. Lock nut | | |

Disassembly (Fig. 14)

1. Remove throttle bracket components from engine as needed using Figure 14 as a guide.

Assembly (Fig. 14)

1. Install removed throttle bracket components to engine using Figure 14 as a guide.
2. Lubricate bellcrank grease fitting after assembly.
3. Check operation and adjustment of accelerator cable (see Operator's Manual). If needed, adjust accelerator cable.
4. Check engine speed (both idle and high idle) and adjust if necessary (see Adjust Engine Speed in Adjustments section of this chapter)



Kohler Gasoline Engine

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Introduction

This Chapter gives information about specifications and repair of the Kohler engine used in the Workman 3100.

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Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kohler Engine Service Manual. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Kohler engines are supplied through your local Kohler dealer or distributor.

Specifications

Item	Description
Make / Designation	Kohler, CH23S, 4–stroke, V–Twin Air Cooled, OHV
Number of Cylinders	2
Bore x Stroke	80 mm x 67 mm (3.15" x 2.64")
Total Displacement	674 cc (41.1 cu. in.)
Compression Ratio	8.5:1
Dry Weight (approximate)	41 kg (90 lb.)
Fuel	Unleaded, Regular Gasoline (Minimum 87 Octane)
Fuel Tank Capacity	26 liters (7 U.S. gal.)
Governor	Mechanical
Idle Speed (no load)	1200 ± 100 RPM
High Idle (no load)	3600 ± 50 RPM
Engine Oil	See Operator's Manual
Oil Pump	Gear driven trochoid type
Crankcase Oil Capacity	1.9 liters (2 U.S. qt.) with filter
Starter	12 VDC

Service and Repairs

Cooling System

To ensure proper engine cooling, make sure the grass screen, cooling fins, and other external surfaces of the engine are kept clean at all times.

NOTE: Perform this maintenance procedure at the interval specified in the Operator's Manual.

IMPORTANT: The engine that powers the Workman 3100 is air-cooled. Operating the engine with dirty or plugged cooling fins, a blocked grass screen, or a plugged or dirty blower housing will result in engine overheating and engine damage.

1. Park vehicle on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).

IMPORTANT: Never clean engine with pressurized water. Water could enter and contaminate the fuel system.

3. Clean cooling fins on both cylinder heads.

4. Clean grass screen and blower housing of dirt and debris (Fig. 1). Remove screen and housing if necessary.

IMPORTANT: Never operate engine without the blower housing installed. Overheating and engine damage will result.

5. Make sure grass screen and blower housing are re-installed to the engine if removed.

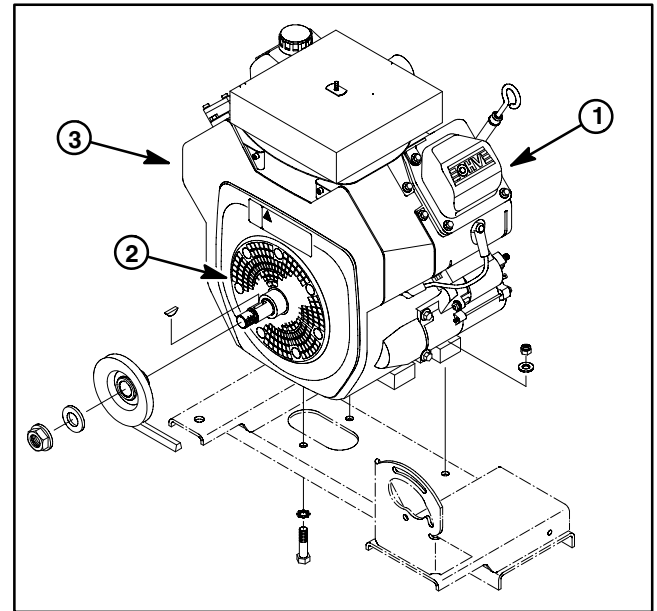


Figure 1

1. Cylinder head
2. Grass screen

3. Blower housing

Fuel Tank

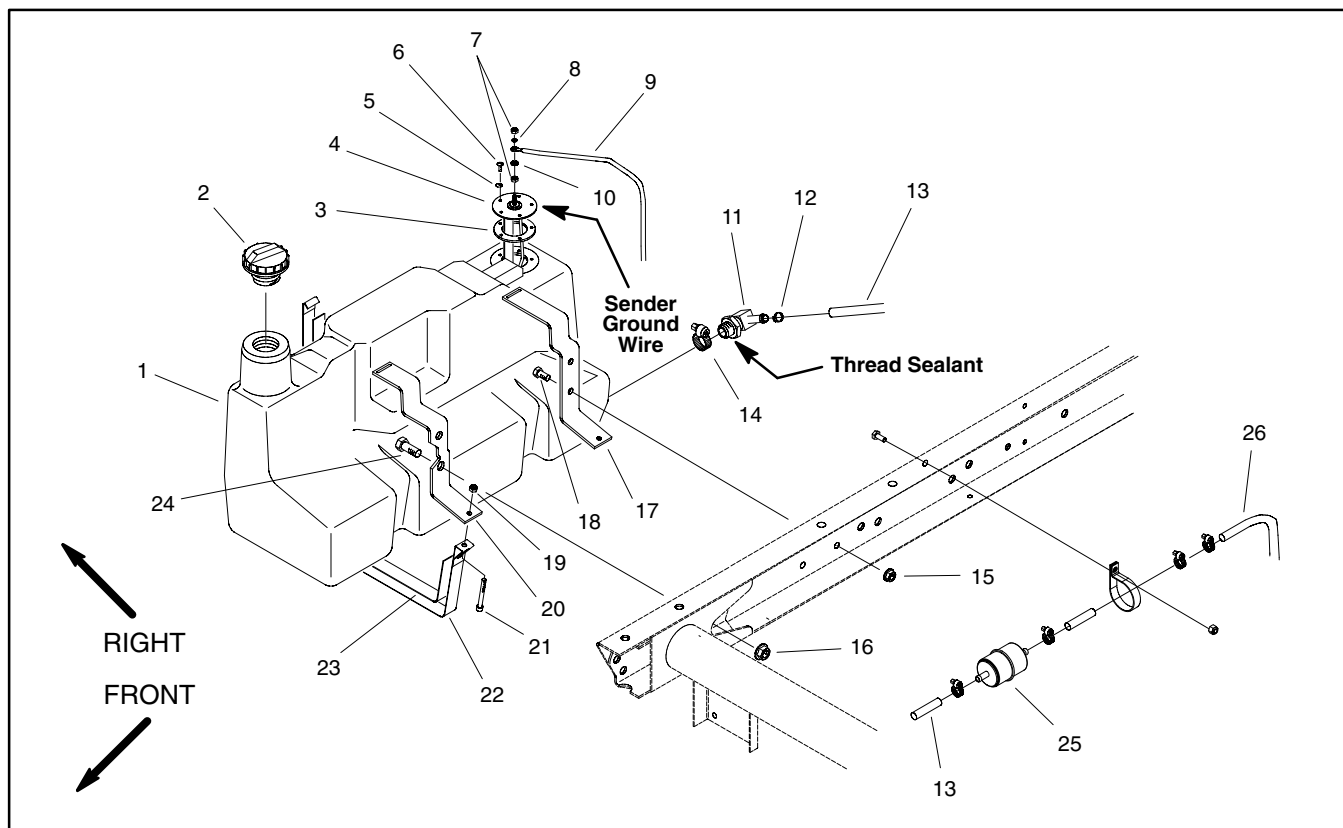


Figure 2

- | | | |
|-------------------------|----------------------------|--------------------------------|
| 1. Fuel tank | 10. Spacer | 19. Lock nut (2 used) |
| 2. Fuel tank cap | 11. Fuel fitting | 20. Front fuel tank support |
| 3. Gasket | 12. Hose clamp | 21. Socket head screw (2 used) |
| 4. Fuel sender | 13. Fuel line | 22. Fuel tank strap (2 used) |
| 5. Lock washer (5 used) | 14. Clamp | 23. Felt strap (2 used) |
| 6. Screw (5 used) | 15. Flange nut (2 used) | 24. Cap screw (2 used) |
| 7. Hex nut | 16. Flange nut (2 used) | 25. Fuel filter |
| 8. Lock washer | 17. Rear fuel tank support | 26. Fuel line (to engine) |
| 9. Wire harness | 18. Cap screw (2 used) | |



DANGER

Because gasoline is highly flammable, use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running, hot, or when vehicle is in an enclosed area. Always fill fuel tank outside and wipe up any spilled fuel before starting the engine. Store fuel in a clean, safety-approved container and keep cap in place. Use fuel for the engine only; not for any other purpose.

Check Fuel Lines and Connections

Check fuel lines and connections periodically as recommended in the Operator's Manual. Check lines for deterioration, damage, leaks, or loose connections. Replace hoses, clamps, and connections as necessary.

Fuel Tank Removal (Fig. 2)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.

2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).

IMPORTANT: Review safety information regarding fuel handling in the Operator's Manual and Chapter 2 – Safety.

3. Disconnect negative battery cable first and then positive battery cable. Remove battery from vehicle (see Operator's Manual).

4. Disconnect fuel line (item 13) from fuel filter on right side frame rail. Drain fuel from the fuel tank into a suitable container.

NOTE: To prevent fuel leakage, do not loosen lower nut on fuel sender stud.

5. Disconnect electrical wiring from the fuel sender on the fuel tank.

6. Loosen socket head screws (item 21) and lock nuts (item 19) to allow tank straps to be unhooked from fuel tank supports.

7. Remove fuel tank from vehicle.

Fuel Tank Installation (Fig. 2)

1. Check felt straps (item 23) and replace if worn or damaged.

IMPORTANT: Make sure that hydraulic lift cylinder does not contact fuel tank.

2. Position fuel tank to tank straps and fuel tank supports. Hook tank straps to fuel tank supports. Tighten socket head screws and lock nuts to secure fuel tank.

3. If fuel fitting was removed from tank, apply thread sealant to threads of fitting before installing fitting into tank.

4. Connect electrical wiring to the fuel sender.

A. Connect blue/white wire with ring terminal to the center fuel sender terminal and secure with lock washer and hex nut.

B. Connect black (ground) wire with the screw (item 6) that is closest to the frame rail.

C. Apply skin-over grease to the wire terminal connections and cover center terminal with harness boot.

5. Connect fuel line from tank outlet to fuel filter and secure with clamp.



CAUTION

Connecting battery cables to the wrong battery post could result in personal injury and/or damage to the electrical system.

6. Position battery in vehicle (see Operator's Manual). Connect positive battery cable first and then negative battery cable.

7. Lower or install the bed or other attachment(s).

8. Fill fuel tank (see Operator's Manual). Check for fuel leakage and correct if found.

Exhaust System

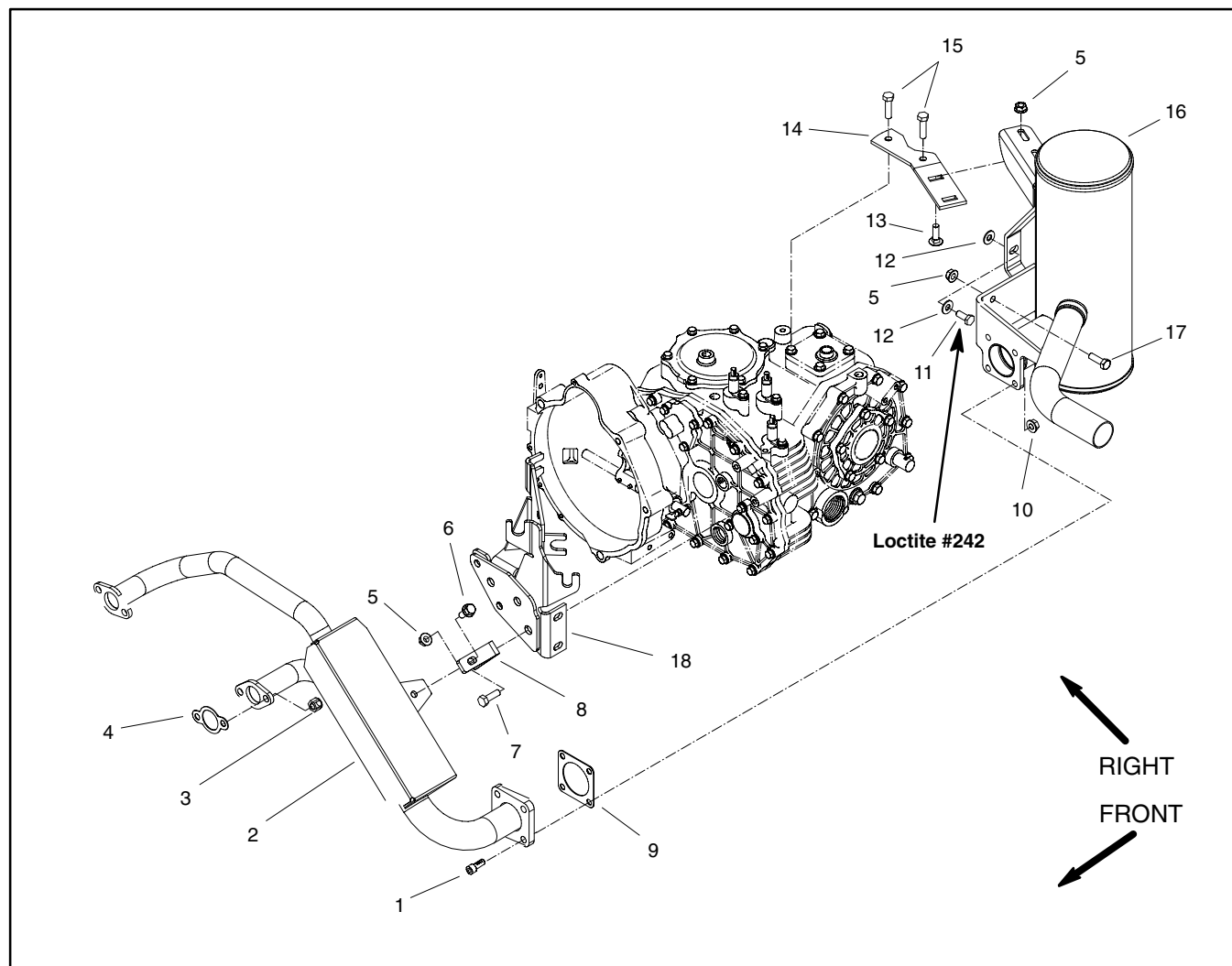


Figure 3

- | | | |
|-------------------------------|-------------------------|-------------------------------|
| 1. Socket head screw (4 used) | 7. Cap screw | 13. Carriage bolt (2 used) |
| 2. Exhaust manifold | 8. Bracket | 14. Mount plate |
| 3. Hex nut (3 used) | 9. Muffler gasket | 15. Cap screw |
| 4. Exhaust gasket (2 used) | 10. Flange nut (4 used) | 16. Muffler |
| 5. Flange nut | 11. Cap screw | 17. Cap screw (2 used) |
| 6. Screw | 12. Hardened washer | 18. Shift cable mount bracket |

Removal (Fig. 3)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.
2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).
3. Remove exhaust system components as needed using Figure 3 as a guide.
4. Discard gaskets and thoroughly clean flange surfaces of manifold and muffler.

Installation (Fig. 3)

1. Replace any removed gaskets.
2. If cap screw (item 11) was removed, apply Loctite #242 (or equivalent) to threads during installation.

3. Using Figure 3 as a guide, fit all exhaust components to vehicle before tightening any fasteners. When securing exhaust, tighten fasteners in the following order:

- A. Hex nuts (item 3) that secure manifold to engine.
 - B. Cap screw (item 11) with washers (item 12) that secures muffler to transaxle.
 - C. Socket head screws (item 1) and flange nuts (item 10) that secure muffler to manifold.
 - D. Cap screws (item 17) and flange nuts (item 5) that secure muffler to shift cable mount bracket.
 - E. Carriage screws (item 13) and flange nuts (item 5) that secure muffler to mount plate.
 - F. Screw (item 6) and flange nut (item 5) that secures exhaust manifold to bracket (item 8).
4. Lower or install bed or attachment(s).

Engine

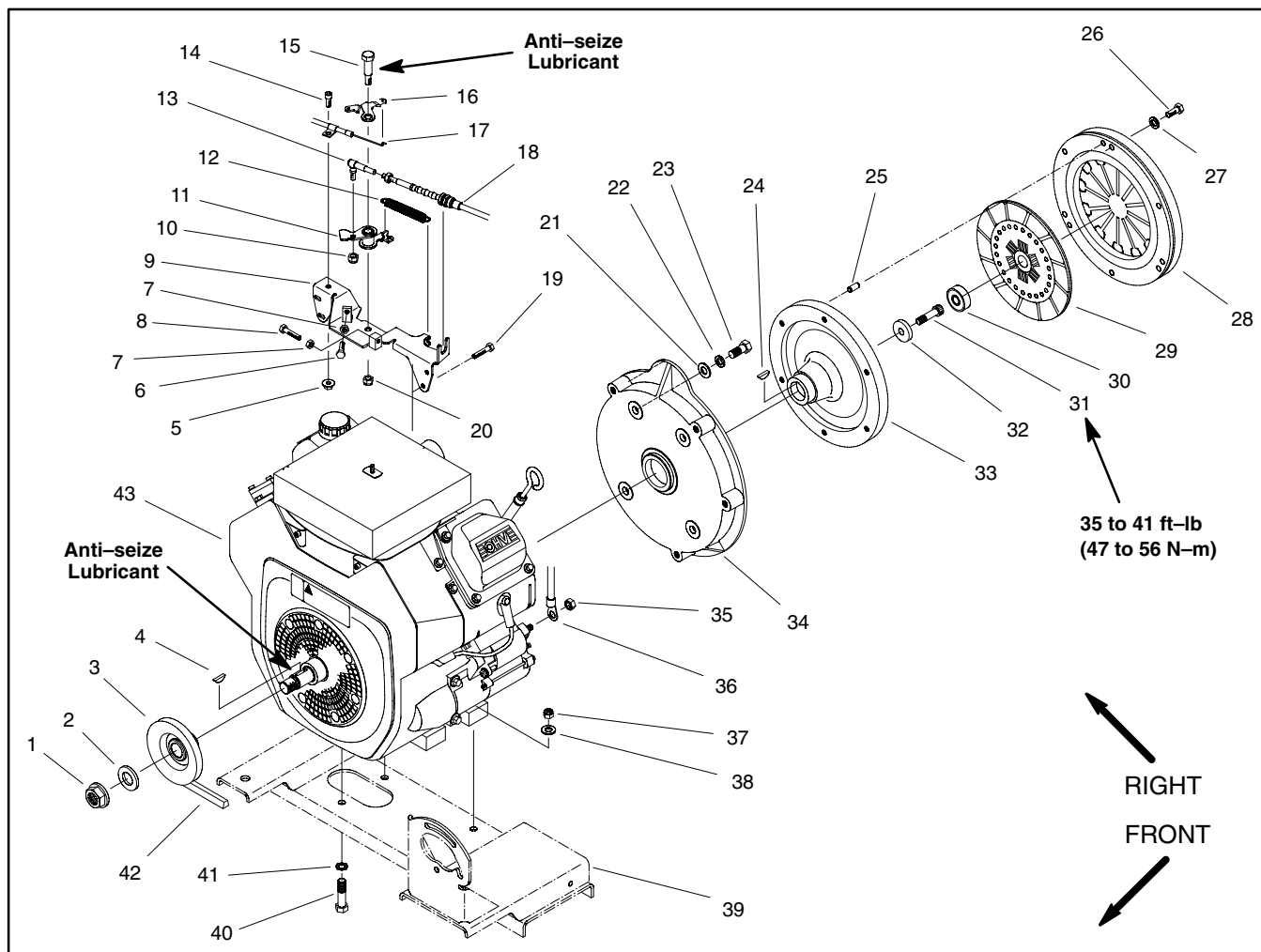


Figure 4

- | | | |
|----------------------------------|--------------------------|----------------------------|
| 1. Lock nut | 16. Choke lever | 30. Pilot bearing |
| 2. Flat washer | 17. Choke cable | 31. Socket head screw |
| 3. Pulley | 18. Accelerator cable | 32. Washer |
| 4. Woodruff key | 19. Cap screw (2 used) | 33. Flywheel |
| 5. Flange nut | 20. Lock nut | 34. Clutch adapter |
| 6. Cap screw | 21. Flat washer (4 used) | 35. Nut |
| 7. Jam nut | 22. Lock washer (4 used) | 36. Positive battery cable |
| 8. Cap screw | 23. Cap screw (4 used) | 37. Lock nut (4 used) |
| 9. Throttle bracket | 24. Woodruff key | 38. Flat washer (4 used) |
| 10. Lock nut | 25. Pin (3 used) | 39. Engine mount |
| 11. Throttle lever | 26. Cap screw (6 used) | 40. Cap screw (4 used) |
| 12. Spring | 27. Lock washer (6 used) | 41. Lock washer |
| 13. Accelerator cable ball joint | 28. Pressure plate | 42. Pump drive belt |
| 14. Socket head screw | 29. Clutch disc | 43. Engine assembly |
| 15. Shoulder bolt | | |

Engine Removal (Fig. 4)

1. Put vehicle on a level surface and engage parking brake. Stop the engine and remove key from ignition switch. Allow engine to cool.

2. Raise or remove the bed or other attachment(s). If bed is raised, place safety support on lift cylinder (see Operator's Manual).

3. Disconnect negative (–) and then positive (+) battery cables at the battery. Disconnect battery cable (Item 36) from starter on engine.

4. Remove the muffler and exhaust manifold (see Remove Exhaust System in this section).

5. Disconnect fuel line from fuel pump on engine. Plug end of fuel line to prevent contamination and fuel spillage. Position disconnected fuel line away from engine.
6. Disconnect and label electrical leads that attach to engine and engine accessories.
7. Loosen fasteners that secure hydraulic pump to engine mount (Fig. 5). Rotate pump to allow drive belt (Item 42) to be removed from pump and engine pulley.
8. Disconnect accelerator cable from throttle lever on engine. Position accelerator cable away from bracket.
9. Disconnect choke cable from choke lever on engine. Remove choke cable from bracket.
10. Remove all clamps and wire ties that attach wiring harness, hoses or cables to the engine.
11. Put blocking under transaxle for support.

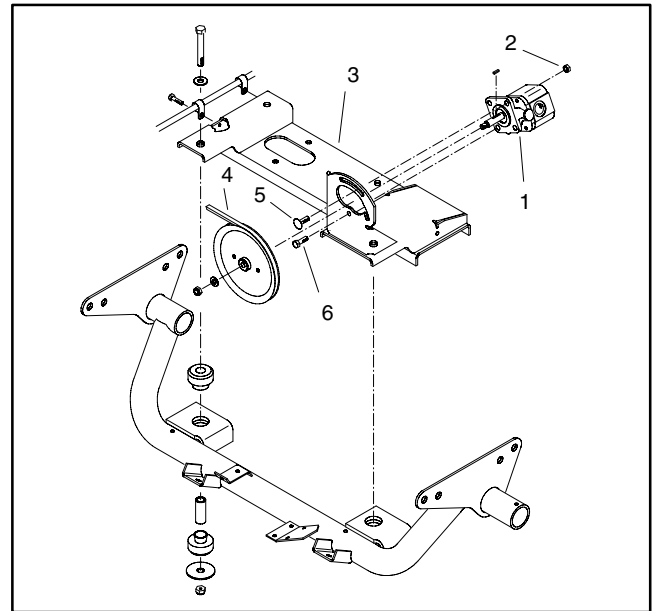


Figure 5

- | | |
|----------------------|--------------------|
| 1. Hydraulic pump | 4. Pump drive belt |
| 2. Lock nut (2 used) | 5. Carriage screw |
| 3. Engine mount | 6. Cap screw |

12. Attach hoist or block and tackle to engine for support.
13. Loosen and remove four (4) lock nuts (Item 37), flat washers (Item 38) and cap screws (Item 40) that secure engine to engine mount. Locate and retrieve lock washer (Item 41) from cap screw on right front corner of engine.
14. Remove four (4) cap screws with lock washers that secure clutch bell housing to engine (Fig. 6).
15. Use a hoist or block and tackle to remove engine from chassis. One person should operate hoist or block and tackle and the other person should help guide engine out of chassis. Move engine forward before lifting to disengage transaxle input shaft from clutch.
16. Note location and retrieve two (2) bushings (Fig. 6, item 2) from bell housing.
17. If necessary, remove hydraulic pump drive pulley from stub shaft on flywheel side of engine. Locate and retrieve woodruff key.

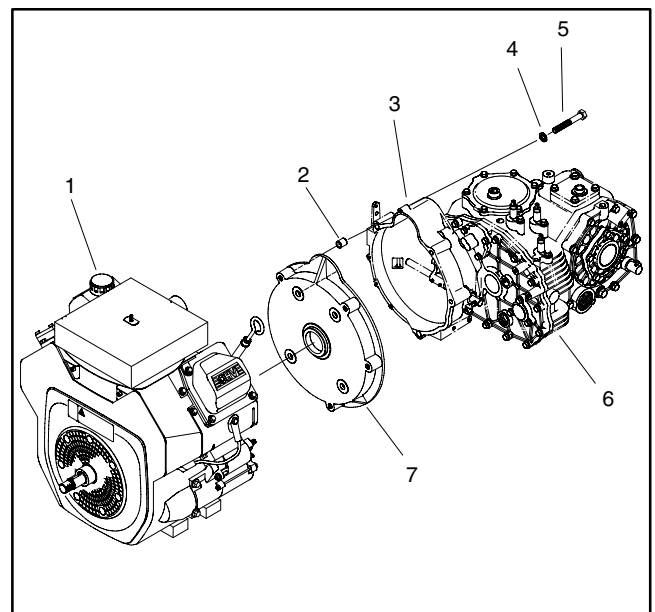


Figure 6

- | | |
|-------------------------|-----------------------|
| 1. Engine | 5. Cap screw (4 used) |
| 2. Bushing (2 used) | 6. Transaxle |
| 3. Clutch bell housing | 7. Clutch adapter |
| 4. Lock washer (4 used) | |

Flywheel and Pilot Bearing Inspection

1. Inspect flywheel (Item 33) surface for stepped wear, streaking or seizure and replace if necessary. Check flywheel runout and replace if runout exceeds .005 in. (0.13 mm).
2. Check pilot bearing (Item 30) for smooth rolling and noise. Check (sealed) bearing for grease leakage. Replace bearing if necessary. Remove pilot bearing by backing out socket head cap screw that attaches flywheel to crankshaft. Do not reuse bearing if removed.

Engine Installation (Fig. 4)

1. Install flywheel (Item 33) and/or pilot bearing (Item 30) if removed. Torque socket head cap screw (Item 31) from 35 to 41 ft–lb (47 to 56 N–m) to secure flywheel to engine crankshaft.
2. If pressure plate and clutch disc were removed, see Installing Clutch Disc and Cover in the Repairs section of Chapter 6 Drive Train.
3. If hydraulic pump drive pulley was removed from engine, apply anti-seize lubricant on shaft surface before installing pulley.
4. To install the engine, perform Engine Removal steps in reverse order. Scrape RTV sealant off engine / bell housing surface. Apply new sealant in same area during engine installation.
5. If shoulder bolt (Item 15) was removed, apply anti-seize lubricant to bolt shoulder before installing.
6. Install a new engine oil filter. Fill engine with the correct oil (see Operator's Manual).
7. Install and adjust hydraulic pump drive belt (see Operator's Manual).
8. Adjust accelerator and choke cables (see Operator's Manual).
9. Lower or install bed or attachment(s).



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General Information

Workman 3000/4000 Series vehicles are equipped with a Toro designed transaxle with 3 forward speeds, 1 reverse speed and a differential lock. Hi-Lo range gives an effective 6 forward and 2 reverse speeds.

The transaxle is a constant mesh, collar shift transmission with synchronizers for gears 1, 2 and 3. Reverse and High-Low range must be shifted with the vehicle stationary.

An optional top mounted PTO operates at 540 RPM.

The transaxle with automotive type clutch is bolted to the engine with the engine/transaxle assembly isolation mounted to the vehicle frame.

Two heavy duty universal drive shafts transfer power from the transaxle to the rear wheels. A fully independent rear suspension and Dedion type rear axle isolate the mid-mounted engine/transaxle assembly from the terrain.

The transaxle housing also functions as the hydraulic system reservoir.

On units equipped with four wheel drive (4WD), the front drive shaft in the transaxle transfers power from the transaxle to the front differential and then to the front wheels.

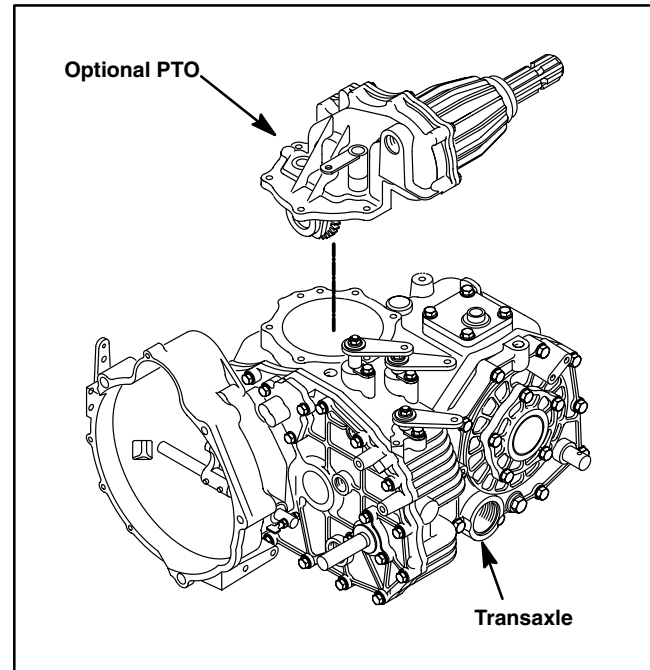


Figure 1

Specifications

Item	Specification
Transaxle Oil	Dexron III ATF
Transaxle Oil Capacity	8 quart U.S. (7.6 liter) system capacity

Special Tools

Order special tools from your Toro Distributor.

Clutch Alignment Tool

Use clutch alignment tool (Part No. TOR6002) to align clutch friction disk to engine flywheel before tightening pressure plate cap screws.



Figure 2

Adjustments

PTO Cable Adjustment

1. Remove clevis pin securing PTO cable to PTO lever arm.
2. Loosen clevis jam nut and adjust clevis so clevis hole aligns with hole in PTO lever arm.
3. Reinstall clevis pin and tighten jam nut after adjustment.

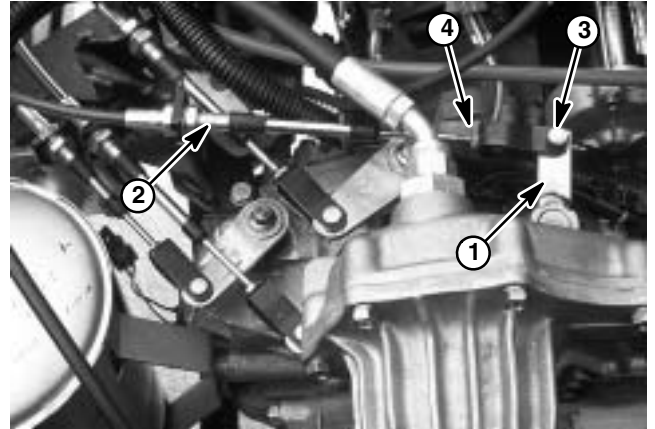


Figure 3

1. PTO lever arm
2. PTO cable

3. Clevis pin
4. Clevis jam nut

Troubleshooting

Clutch

Problem	Possible Causes
Clutch slips.	Excessive wear of clutch disc facing. Clutch pedal out of adjustment. Hardening of clutch disc facing, or adhesion of oil. Weak or broken clutch diaphragm spring. Damaged pressure plate or flywheel.
Clutch operation erratic or rough.	Improper installation of clutch cover assembly. Damaged clutch disc. Excessive wear of clutch disc facing. Weak or broken clutch torsion spring. Damaged or broken clutch pressure plate. Bent or broken clutch diaphragm spring tip. Dirty or improperly lubricated clutch disk spline. Damaged or distorted flywheel. Damaged release bearing.
Clutch noisy.	Improper installation of clutch cover assembly. Excessive wear of clutch disc facing. Worn clutch disc spline. Weak or broken clutch torsion spring. Damaged pilot bushing. Damaged release bearing.

Clutch (Continued)

Problem	Possible Causes
Clutch drags or does not release.	Control cable loose or out of adjustment. Bent or broken clutch diaphragm spring tip. Damaged or distorted clutch disc. Worn or rusted clutch disc spline. Damaged pressure plate or flywheel. Damaged release bearing.
Clutch chatters.	Worn or damaged clutch disc facing. Oil adhered to clutch disc facing. Uneven height of diaphragm spring. Weak or damaged clutch torsion spring. Damaged pressure plate or flywheel. Damaged clutch release bearing. Loose or worn front wheel bearings.

Transaxle

Problem	Possible Causes
Noisy operation.	Low oil level in transaxle. Damaged or worn bearings. Gears worn, scuffed or broken. Excessive end play in countershaft. Gears loose on shaft. Excessive wear of differential side gear liners and pinion liners. Excessive wear of splined slider on axle drive joints.
Difficult shifting.	Clutch not releasing. Shift cable out of adjustment. Shift cable damaged. Shifter cap screw loose (at operator station). Loose shift lever on transaxle. Cable clamp securing cables near shifter is loose. Sliding gear tight on shaft or splines. Synchronizing unit damaged. Sliding gear teeth damaged. Synchronizer keys damaged.
Gears make clashing noise when shifting.	Shifting too fast. Excessive wear of synchro rings. Excessive wear of differential side gear liners and pinion liners. Damaged synchro springs and/or keys. Main gear needle bearings worn or damaged. Excessive wear of drive shaft(s).
Transaxle sticks in gear.	Clutch not releasing. Shift fork detent ball stuck. Shift linkage damaged, loose or out of adjustment. Sliding gears tight on shaft splines. Synchronizer shift keys damaged.

Transaxle (Continued)

Problem	Possible Causes
Transaxle slips out of gear.	Shift linkage out of adjustment. Gear loose on shaft. Gear teeth worn. Excessive end play in gears. Lack of spring pressure on shift fork detent ball. Badly worn bearings.
Overheating of transaxle.	Oil level too high. Excessive hydraulic load. See Chapter 9 – Hydraulic System.

Service and Repairs

Shift Cable Replacement

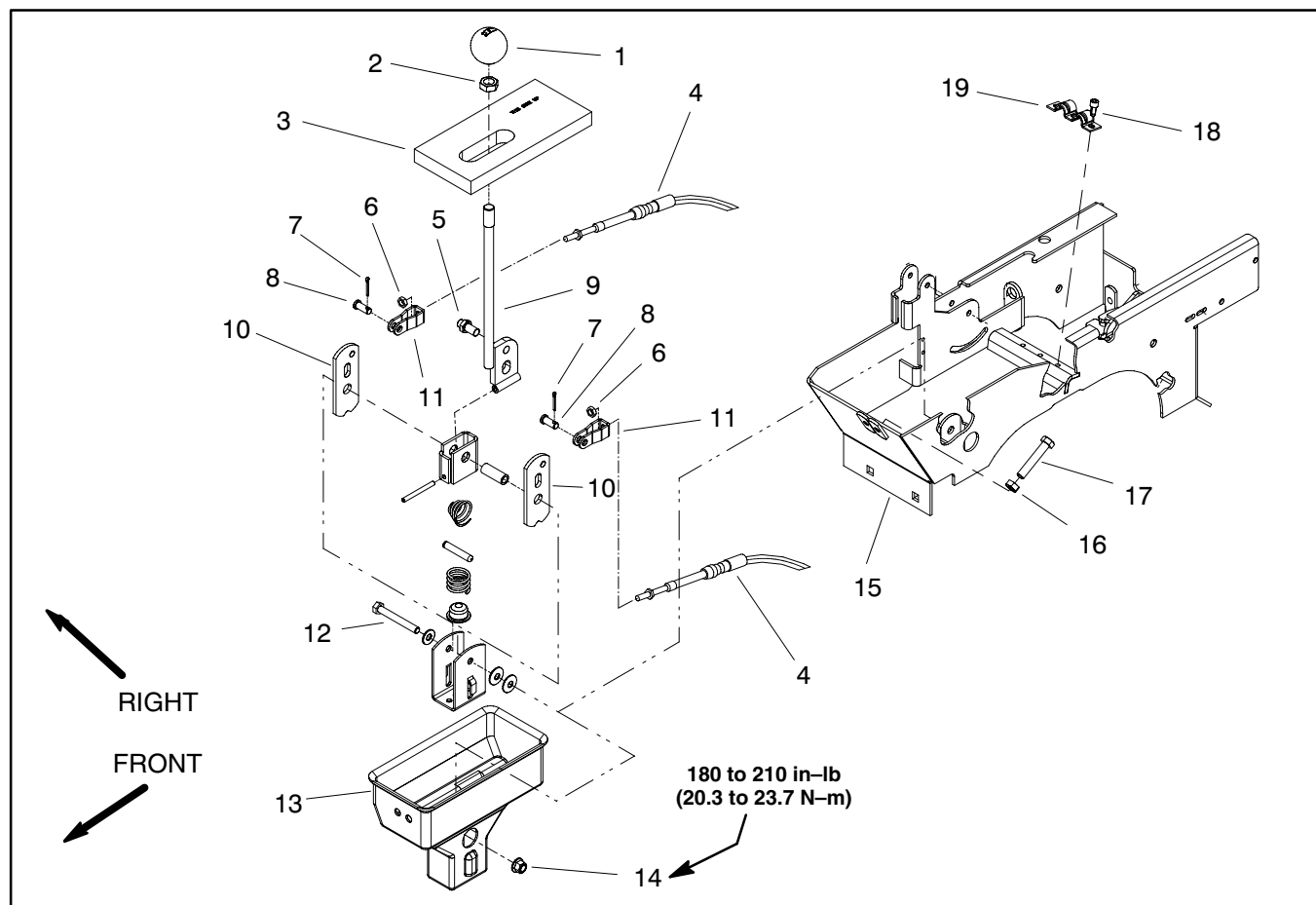


Figure 4

- 1. Shift knob
- 2. Jam nut
- 3. Boot seal
- 4. Shift cable
- 5. Shift pin
- 6. Jam nut
- 7. Cotter pin

- 8. Clevis pin
- 9. Shift lever
- 10. Shift link
- 11. Cable clevis
- 12. Cap screw
- 13. Lower shift boot

- 14. Lock nut
- 15. Lever support
- 16. Hex nut (2 used)
- 17. Shift stop bolt (2 used)
- 18. Screw (3 used)
- 19. Cable clamp

Removal (Fig. 4)

1. Remove knobs from control levers, then remove center console shift boot and control plate (Fig. 5).
2. Remove three screws (Item 18) and cable clamp (Item 19) that secure shift cables to lever support.
3. Remove cotter pin and clevis pin that secure shift cable clevis to shift link (Item 10) on shifter in operator platform.
4. Loosen jam nut that retains clevis to shift cable and remove clevis from cable.
5. Remove shift cable from transaxle shift lever (Fig. 7):
 - A. Remove cotter pin and clevis pin that secure shift cable to shift lever on transaxle.
 - B. Loosen jam nuts on bulkhead fitting of cable.
 - C. Disconnect cable from shift lever.
6. Note routing of shift cable and location of cable ties used to secure cable. Slide shift cable from lower shift boot and remove cable from vehicle.

Installation (Fig. 4)

1. Route cable in same location as before.
2. Install cable clevis on shift cable. Adjust cable clevis as shown in Figure 6. Tighten jam nut to secure clevis to cable.
3. Connect shift cable to shift link (Item 10) on shifter in operator platform by inserting clevis pin (Item 8) from the passenger side, then install cotter pin.
4. Secure shift cables to lever support with cable clamp (Item 19) and three screws (Item 18).
5. Spread jam nuts on bulkhead fitting of cable (Fig. 7). With cable properly routed to transaxle, install cable bulkhead fitting to shift cable mount bracket on transaxle and tighten jam nuts.
6. Install cable ties in the original locations to secure shift cables to vehicle.
7. Adjust shift cables (see Operator's Manual) and secure cable clevis to transaxle shift lever with clevis pin and cotter pin.
8. Check adjustment of shift stop bolts. Move shift lever forward until lever stops. Hold lever in stopped position and adjust stop bolt so that head just contacts lever. Tighten hex nut on stop bolt.
9. Install shift boot, control plate and control lever knobs.

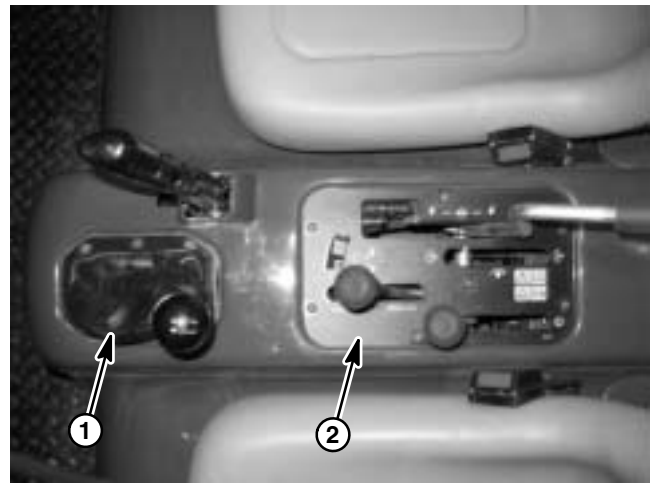


Figure 5

1. Shift boot

2. Control plate

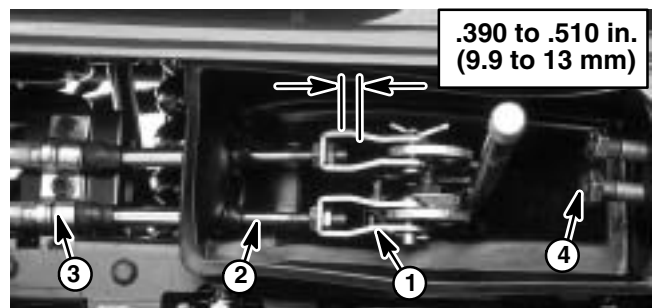


Figure 6

1. Clevis

2. Shift cable

3. Clamp

4. Shift stop bolt

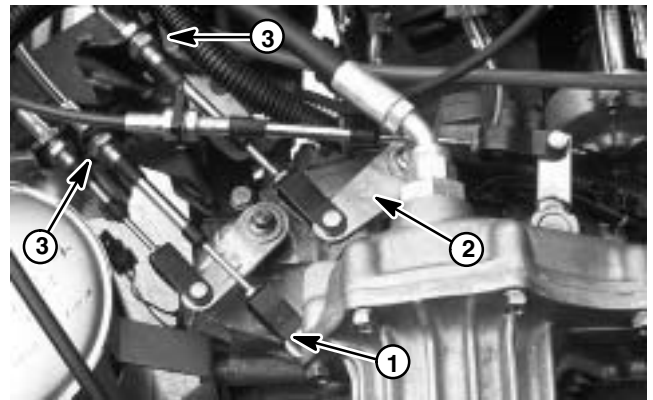


Figure 7

1. First-Reverse

2. 2nd-3rd

3. Bulkhead jam nut

Stub Axle and Drive Shaft Service

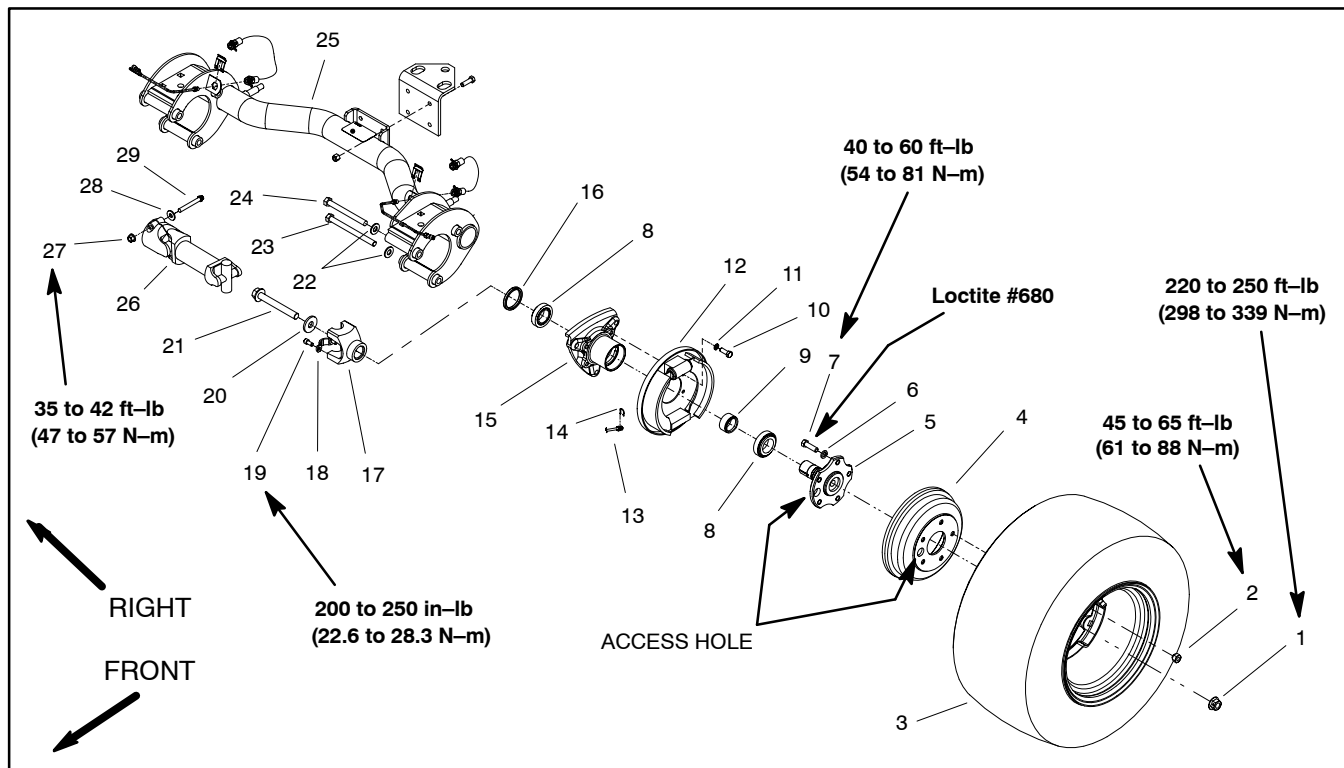


Figure 8

- | | | |
|-----------------------------------|------------------------------------|-----------------------|
| 1. Flange nut | 11. Lock washer (4 used per brake) | 21. Flange head screw |
| 2. Wheel nut (5 used per wheel) | 12. Brake assembly | 22. Thrust washer |
| 3. Wheel assembly | 13. Parking brake cable | 23. Cap screw |
| 4. Brake drum | 14. Cable clip | 24. Cap screw |
| 5. Stub axle | 15. Axle housing | 25. Rear axle |
| 6. Lock washer (5 used per wheel) | 16. Seal | 26. Drive shaft |
| 7. Hex bolt (5 used per wheel) | 17. End yoke | 27. Flange nut |
| 8. Bearing | 18. Yoke strap (2 used per yoke) | 28. Hardened washer |
| 9. Bearing spacer | 19. Bolt (2 used per strap) | 29. Cap screw |
| 10. Cap screw (4 used per brake) | 20. Hardened washer | |

Disassembly (Fig. 8)

1. Loosen wheel nuts.

2. Jack up rear of vehicle and support vehicle with jack stands (see Jacking Instructions in Operator's Manual). Remove wheel nuts and then remove wheel assembly.

NOTE: It may be necessary to back off brake adjuster to remove brake drum. To back off adjuster, rotate brake drum until access hole lines up with star wheel on adjuster assembly. Use a hooked piece of wire to pull pawl away from star wheel, then turn star wheel.

3. Remove brake drum.

NOTE: Loosening driveshaft at transaxle will allow easier driveshaft removal from end yoke.

4. Loosen and remove flange nuts, cap screws, and hardened washers securing driveshaft to splined axle shaft of transaxle (Fig. 9).

5. Remove the yoke straps (18) securing driveshaft bearing cross to the end yoke (17), then disconnect driveshaft from the end yoke.

6. Loosen flange nut (1) that secures end yoke to stub axle (5). Remove flange nut and flange head screw (21). Discard flange nut. Pull end yoke from stub axle.

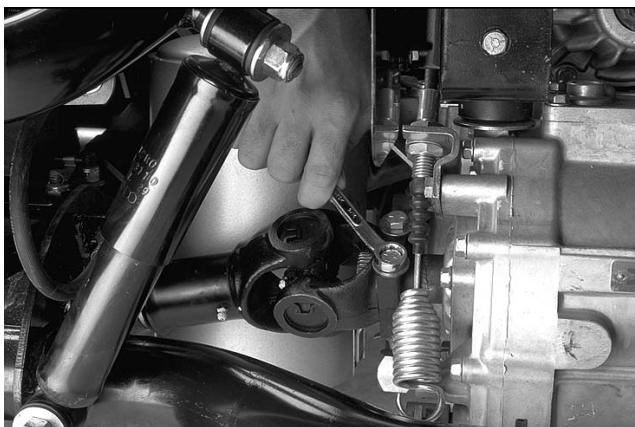


Figure 9

7. Carefully slide stub axle from axle housing.
8. If required, slide driveshaft from transaxle.
9. If bearings are being serviced, remove axle housing (15) from vehicle:

A. Remove brake assembly from axle housing (see Brake Service in Service and Repairs Section of Chapter 7 – Chassis).

B. Remove three (3) cap screws with washers that secure axle housing to vehicle frame. Remove axle housing. NOTE: Upper cap screw for LH axle housing is shorter than other cap screws used to secure axle housing to frame.

Bearing Service (Fig. 8)

1. Inspect bearings and replace if necessary. If outer bearing is removed from stub axle, bearing set must be replaced.
2. Remove bearing seal from back of axle housing.
3. Remove inner bearing cone. Slide bearing spacer from axle housing noting orientation of bearing spacer step (away from stub axle flange).
4. Press inner and outer bearing cups from housing. Press outer bearing cone from stub axle.
5. Clean all parts thoroughly before reassembly.
6. Position inner and outer bearing cups to axle housing. Press bearing cups into housing until they seat against the housing shoulder.
7. Pack bearings with lithium based grease.
8. Position outer bearing cone, wide end first, onto stub axle. Press bearing onto stub axle putting pressure on inner race of bearing.
9. Insert stub axle with bearing into axle housing. Fill housing with grease.
10. Insert bearing spacer onto stub axle inside housing. NOTE: The stepped end of bearing spacer should be positioned away from stub axle flange.
11. Insert inner, greased bearing, small end first, onto stub axle inside housing.

IMPORTANT: The bearing seal must be pressed in so it is flush with the end of the axle housing. The lip of the seal must be toward the bearing.

12. Install new seal over shaft and into housing with the seal lip inward. Be careful not to damage the seal during installation.

Assembly (Fig. 8)

1. If driveshaft was removed from transaxle, apply anti-seize lubricant to transaxle shaft. Slide driveshaft clamp end onto splined transaxle shaft.
 2. If removed, install axle housing to frame:
 - A. Position axle housing to frame and install three cap screws to secure axle housing to vehicle frame. NOTE: Upper cap screw for LH axle housing is shorter than other cap screws used to secure axle housing to frame.
 - B. Install brake assembly to axle housing (see Brake Service in Service and Repairs Section of Chapter 7 – Chassis).
 3. If wheel studs were removed from stub axle, apply Loctite #680 (or equivalent) to threads near head of stud. Install stud with lock washer into stub axle and torque from 40 to 60 ft-lb (54 to 81 N-m).
 4. Insert stub axle with greased bearing into axle housing. Be careful not to damage the bearing seal during installation.
 5. Slide end yoke onto stub axle shaft.
- IMPORTANT: Flange nut (1) should be replaced whenever it is removed.**
6. Insert flange head screw through end yoke and stub axle. Install new flange nut onto screw. Torque flange nut from 220 to 250 ft-lb (298 to 339 N-m).
 7. Position driveshaft cross to the end yoke. Install the straps to secure driveshaft bearing cross to the end yoke. Torque bolts from 200 to 250 in-lb (22.6 to 28.3 N-m).
 8. Lubricate driveshaft grease fittings (see Operator's Manual).
 9. Secure drive shaft to transaxle shaft (Fig. 9):
 - A. Align mounting holes in driveshaft with relief in transaxle shaft.
 - B. Install cap screws, hardened washers, and flange nuts to secure driveshaft to transaxle shaft. Torque fasteners from 35 to 42 ft-lb (47 to 57 N-m).
 10. Install brake drum and wheel (see Brake Service in Service and Repairs Section of Chapter 7 – Chassis).
 11. Tighten wheel nuts to a torque of 45 to 65 ft-lb (61 to 88 N-m).
 12. Lower vehicle to ground.

Drive Shaft Universal Joint Service

1. Remove drive shaft from vehicle (see Stub Axle and Drive Shaft Service).

2. Remove snap rings (Item 1).

IMPORTANT: Yokes must be supported when removing and installing bearings to prevent bending.

3. While supporting yoke, use a press to remove cross and bearings (Item 2).

4. To install new cross and bearings:

A. Apply a coating of grease to bearing bores.

B. Press one bearing partially into yoke (Item 3).

C. Insert cross into yoke and bearing.

D. Hold cross in alignment and press bearing in until it hits the yoke.

E. Install snap ring into groove by first bearing cap installed.

F. Place second bearing into yoke bore and onto cross shaft. Press second bearing into yoke.

G. Tap axle yoke outward with hammer and alignment punch to allow 2nd snap ring to fit. Install snap ring.

H. Repeat procedure for other yoke.

I. Grease cross until grease comes out of all four (4) cups.

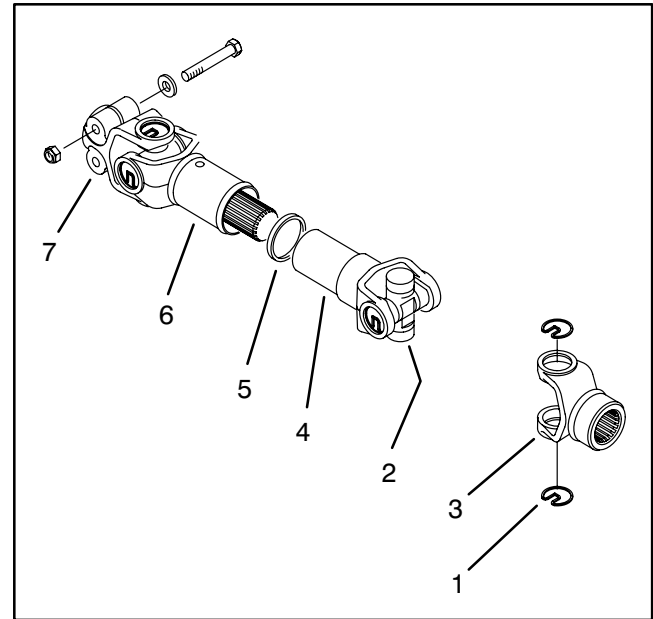


Figure 10

- | | |
|-----------------------|--------------|
| 1. Snap ring | 5. Seal |
| 2. Cross and bearings | 6. Shaft |
| 3. End yoke | 7. Tube yoke |
| 4. Yoke and hub | |

P.T.O. Removal and Installation (If Equipped)

PTO Removal

1. Remove clevis pin to disconnect PTO control cable clevis from shift arm on PTO. Do not loosen jam nuts to remove cable from support bracket.
2. Disconnect and label electrical lead that attaches to PTO switch.
3. Disconnect hydraulic hose from fitting on PTO. Put labels on hydraulic hoses for proper reassembly. Put caps or plugs on all open hoses or fittings to prevent contamination. Label hoses and fittings for proper reinstallation.
4. Loosen cap screws and remove nut with washer. Separate P.T.O. and O-ring from transaxle case. Locate and remove two alignment pins.

PTO Installation

1. Apply multi-purpose grease to O-ring and insert O-ring into groove of transaxle case. Insert 2 alignment pins in transaxle case.

IMPORTANT: When installing PTO assembly, make sure O-ring is properly positioned in groove.

2. Install PTO to transaxle. Tighten cap screws and nut with lockwasher to a torque from 11 to 13 ft-lb (15 to 17 N-m).
3. Install hydraulic hose to fitting on PTO.
4. Connect PTO switch electrical lead.
5. Loosen clevis jam nut and adjust clevis so clevis hole aligns with hole in PTO arm.
6. Reinstall clevis pin and tighten jam nut after doing adjustment.

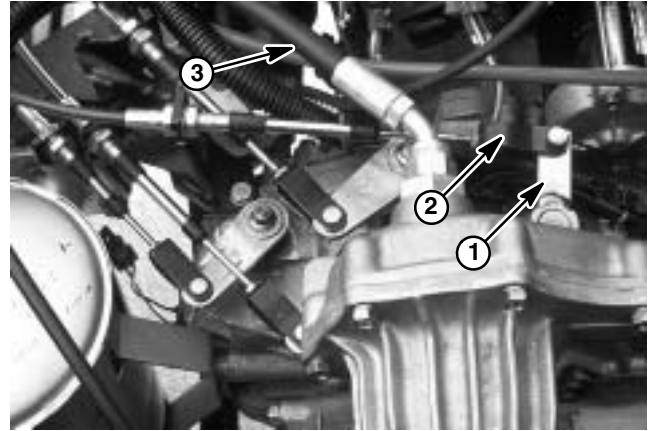


Figure 11

1. PTO lever arm
2. Cable clevis

3. Hydraulic hose

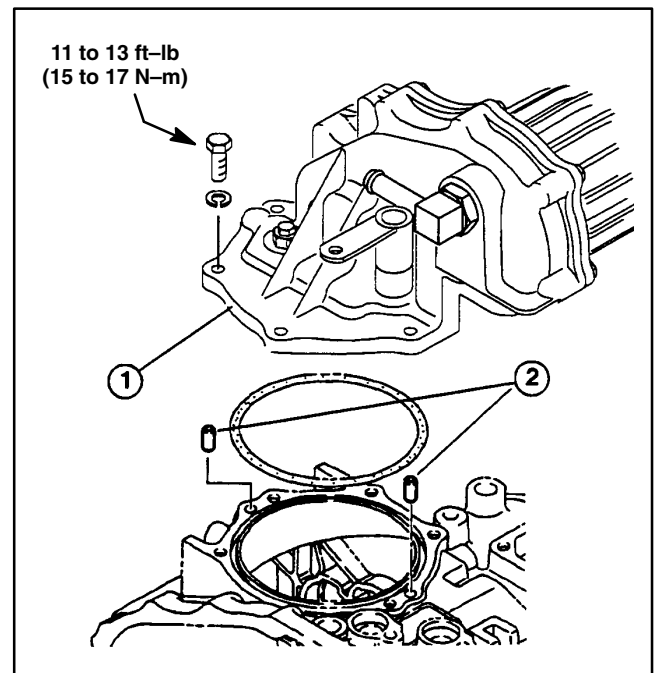


Figure 12

1. PTO assembly

2. Alignment pins

Transaxle

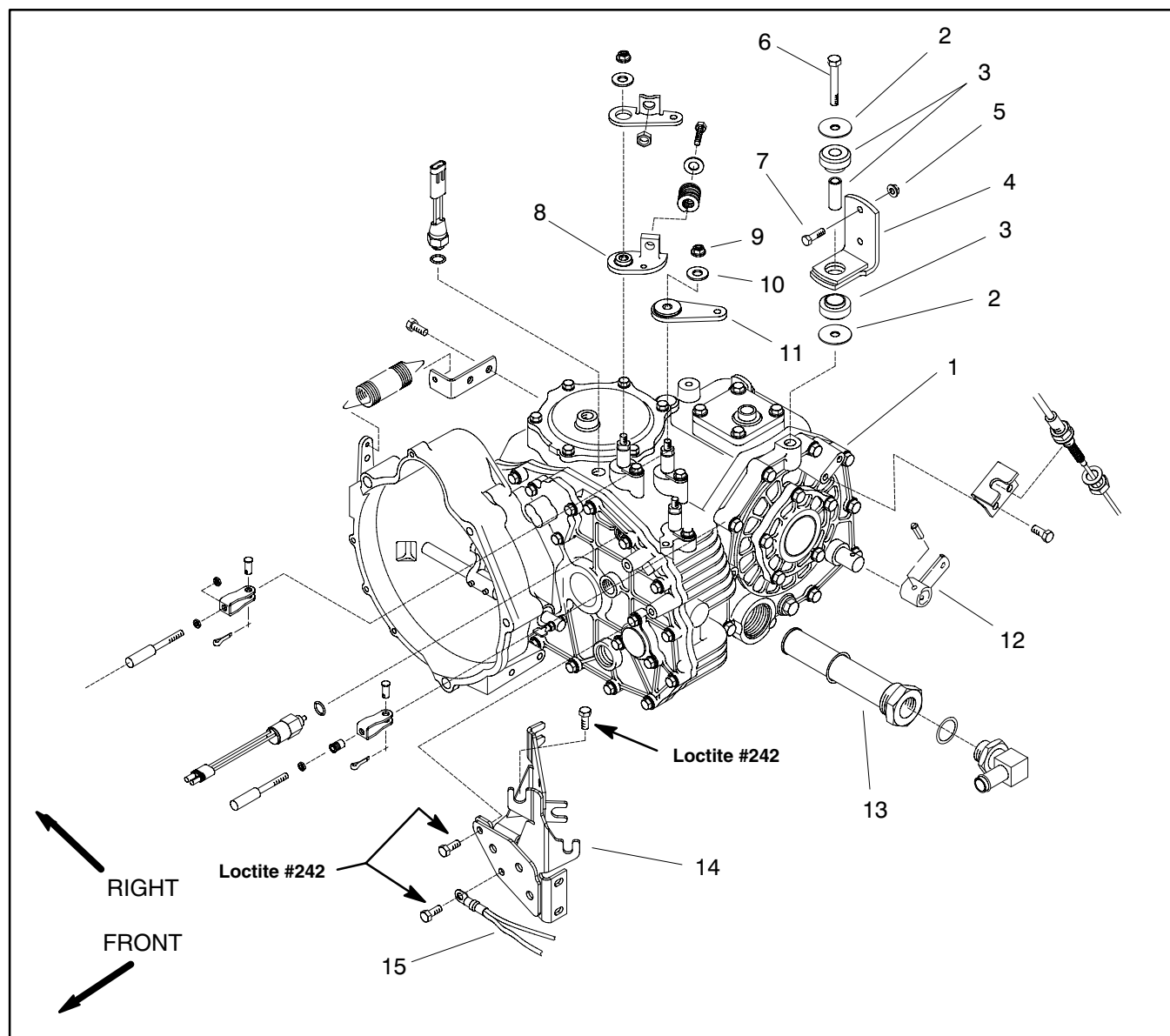


Figure 13

- | | | |
|--------------------------------------|------------------------------|-------------------------------|
| 1. Transaxle assembly | 6. Cap screw (2 used) | 11. Shift lever (2 used) |
| 2. Snubbing washer (4 used) | 7. Cap screw (4 used) | 12. Differential lock lever |
| 3. Isolation mount assembly (2 used) | 8. Shift arm | 13. Strainer |
| 4. Transaxle mount (2 used) | 9. Nut (3 used) | 14. Shift cable mount bracket |
| 5. Lock nut (4 used) | 10. Hardened washer (3 used) | 15. Negative battery cable |

Removal

1. Put vehicle on a level surface. Stop the engine and remove key from ignition switch. Remove the bed or other attachment(s). Allow engine and radiator to cool.
2. Disconnect negative (–) battery cable from battery first. Then disconnect positive (+) battery cable from battery.
3. Remove drain plug from bottom of transaxle (Fig. 14) and allow oil to drain into a drain pan. Install drain plug.
4. Note orientation of 90° fitting connected to strainer on side of transaxle. Remove hydraulic hose and 90° fitting from strainer (Fig. 14).
5. Remove muffler (see Muffler Removal in Engine Chapter).
6. Remove hydraulic filter assembly and bracket.
7. Disconnect and label electrical leads that attach to transaxle and PTO.
8. Disconnect clutch cable from clutch release lever, then loosen jam nut to remove clutch cable from support bracket (Fig. 15).
9. Loosen jam nut to remove differential lock cable from support bracket, then disconnect differential lock cable from lever at left rear of transaxle (Fig. 16).
10. Disconnect shifter control cables from levers on transaxle and PTO. Do not loosen cable jam nuts at shift cable mount bracket.
11. Remove shift cable mount bracket from transaxle, keeping shifter control cables attached to bracket. Position bracket away from transaxle.
12. On Workman 4000 series vehicles (4 Wheel Drive), remove differential drive shaft, bidirectional clutch, and adapter plate from the transaxle (see Service and Repairs section of Chapter 10 – Front Wheel Drive (4WD)).
13. Disconnect return hydraulic hose from transaxle (or PTO if equipped). Put label on hydraulic hose for proper reassembly. Put caps or plugs on all open hoses or fittings to prevent contamination.
14. Remove PTO, if equipped, from top of transaxle (see PTO Removal and Installation).
15. Block front wheels. Jack-up rear of vehicle under rear axle and install jack stands so transaxle can be removed by sliding out from under rear axle (see Jacking Information in Operator's Manual).

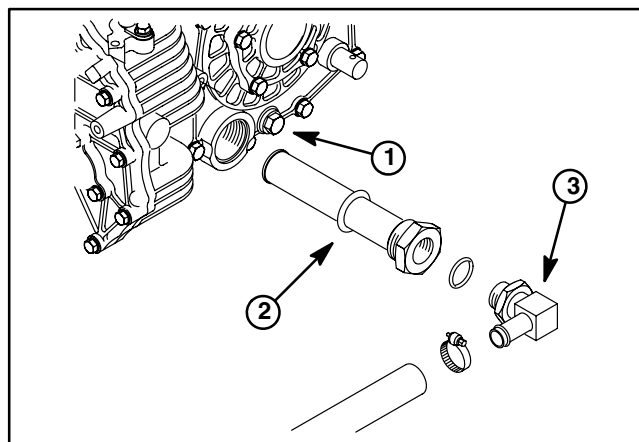


Figure 14

1. Drain plug
2. Strainer
3. 90° fitting

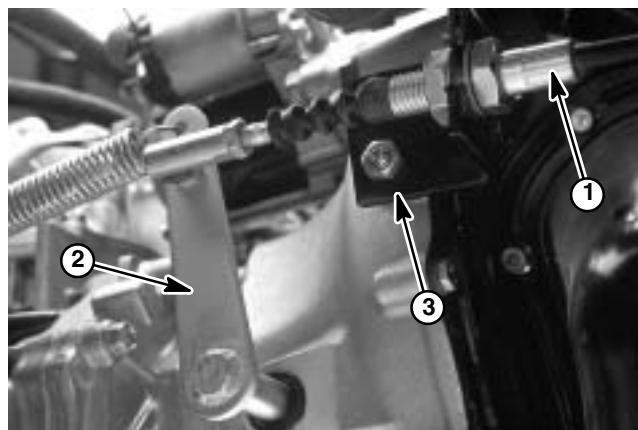


Figure 15

1. Clutch cable
2. Clutch release lever
3. Support bracket

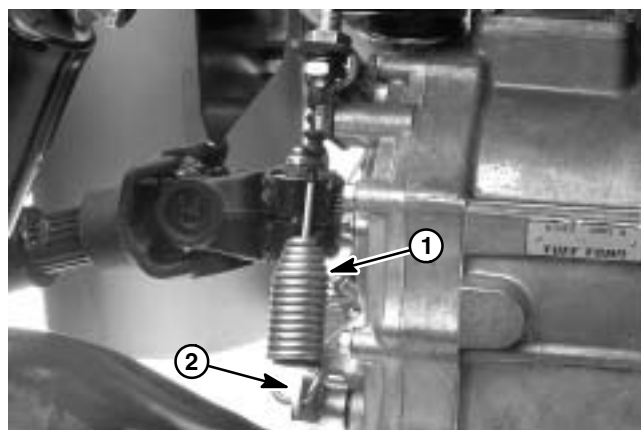


Figure 16

1. Differential lock cable
2. Differential lock lever

16. Put blocking under engine for support. Support transaxle with a floor jack or suspend transaxle from vehicle frame rails.

17. Remove transaxle isolation mounts and mount brackets (Fig. 17).

18. Remove drive shaft clamp bolts, then slide transaxle side-to-side to disconnect each drive shaft from axle shafts on transaxle.

19. Remove cap screws securing clutch bell housing to engine. Note location of washers and harness brackets.

20. Carefully pull transaxle back to disengage transaxle input shaft from clutch. Use floor jack to lower transaxle and slide out rear of vehicle under the frame.

21. Note location and retrieve dowel pins from bell housing.

Installation

1. To install the transaxle, perform Transaxle Removal procedure in reverse order noting the following:

IMPORTANT: Workman 3100 (air cooled, gasoline engine) vehicles require application of silicone sealant to mating surface of bell housing and clutch adapter plate on engine. This will prevent dirt and debris from getting into bell housing and damaging clutch or release bearing.

A. When installing driveshafts to transaxle, align mounting holes in driveshaft with relief in transaxle shaft. Install cap screws, hardened washers, and flange nuts to secure driveshaft to transaxle shaft. Torque fasteners from 35 to 42 ft-lb (47 to 57 N-m).

B. Apply Loctite #242 (or equivalent) to the threads of cap screws used to secure the control cable support bracket to the transaxle.

C. Before installing two shift levers and shift arm onto transaxle shafts, thoroughly clean shafts and apply Loctite #680 to threads and tapers of shafts. Secure by torquing nut from 200 to 280 in-lb (22.6 to 31.6 N-m) while holding lever to prevent torque transfer into transaxle (Fig. 19).

2. Install a new hydraulic oil filter and fill transaxle with the correct oil (see Operator's Manual). Check for oil leaks and repair as necessary.

3. Adjust clutch pedal, shift cables, high-low cable and differential lock cable (see Operator's Manual).

4. If equipped with PTO, adjust PTO cable (see PTO Cable Adjustment in the Adjustments section of this chapter).

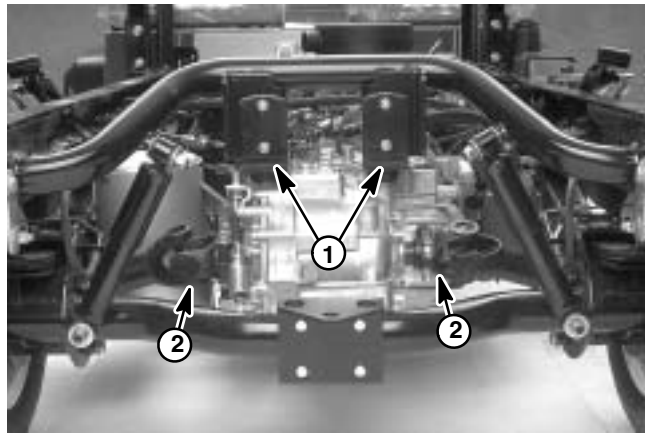


Figure 17

1. Mounting brackets 2. Drive shaft

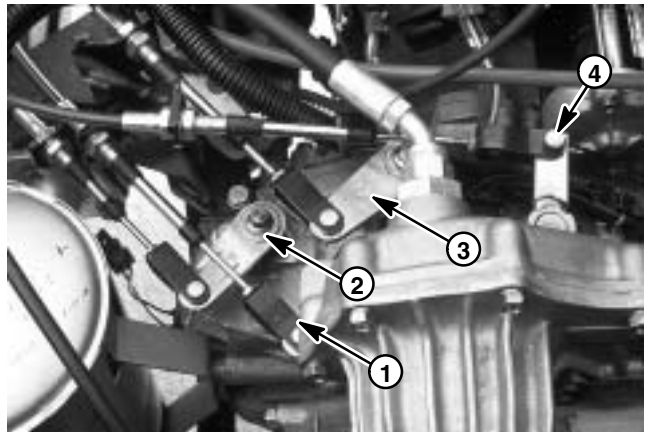


Figure 18

1. First-Reverse 3. 2nd-3rd
2. High-Low 4. PTO clutch

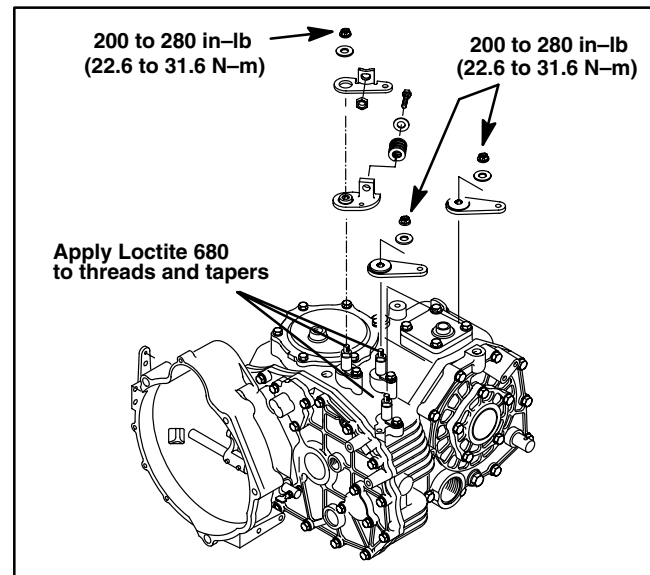


Figure 19

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Clutch Service

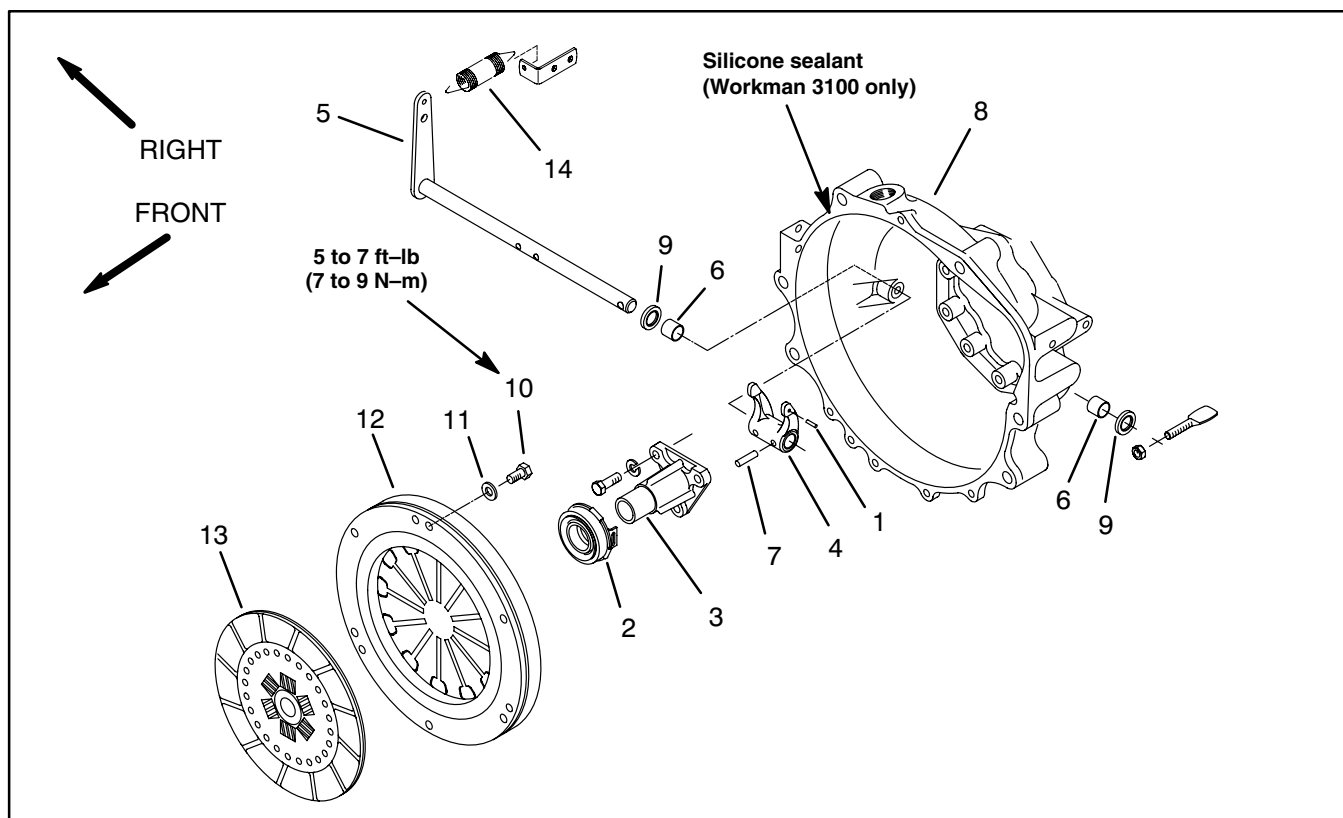


Figure 20

- | | | |
|-------------------------|------------------------|--------------------------|
| 1. Spring pin | 6. Bushing | 11. Lock washer (6 used) |
| 2. Throw out bearing | 7. Spring pin (2 used) | 12. Pressure plate |
| 3. Release guide | 8. Bell housing | 13. Clutch disc |
| 4. Clutch release fork | 9. Oil seal | 14. Spring |
| 5. Clutch release shaft | 10. Cap screw (6 used) | |

Clutch Release Mechanism (Fig. 20)

1. Remove transaxle (See Transaxle Removal in this section).
2. Inspect main shaft of transaxle for wear or damaged splines.
3. Remove roll pin (Item 1), then remove throw out bearing (Item 2). Inspect bearing and replace if it is loose on the sleeve, if it appears burned or is worn. Make sure bearing slides freely on release guide (Item 3).
4. Inspect clutch fork (Item 4), release shaft (Item 5), and bushings (Item 6) for wear or damage. Inspect extension spring (Item 14). Replace worn or damaged parts. Replace seals (Item 9).

5. During assembly, apply anti-seize lubricant to the following:

- A. Fill annular groove of release bearing and coat remainder of bearing bore.
- B. Apply thin coat to outside diameter of release guide.
- C. Apply thin coat to fingers of clutch release fork.
- D. Remove any excess lubricant before final assembly.

Clutch Disassembly and Inspection (Fig. 20)

1. Insert clutch alignment tool (see Special Tools) in flywheel pilot bearing hole to keep clutch disk from falling off (Fig. 21).
2. Loosen pressure plate screws (Item 10) in a diagonal sequence.
3. Remove cap screws, washers (Item 11) and pressure plate (Item 12), then slide out the transaxle main shaft and remove clutch disk (Item 13). Note orientation of clutch disk as it is removed (Fig. 22).
4. Inspect diaphragm spring end of pressure plate for wear and uneven height. Replace if wear is evident or if height difference exceeds 0.020 in. (0.5 mm).
5. Check pressure plate surface for wear, cracks and color change.
6. Check strap plate rivets for looseness and replace pressure plate if loose.
7. Check clutch disk facing for loose rivets, uneven contact, deterioration due to seizure, adhesion of oil or grease. Replace clutch disk if damaged.
8. Measure rivet sink and replace clutch disk if out of specification (Fig. 24).

Clutch disk thickness standard value	0.307 to 0.339 in. (7.8 to 8.6 mm)
Clutch disk rivet sink	0.012 in. (0.3 mm) minimum

9. Check for torsion spring play or damage. Replace clutch disk if necessary.
10. Install clutch disk on transaxle main shaft. Make sure clutch slides freely on splines of shaft. Check for excessive play in rotating direction.
11. Inspect flywheel surface for stepped wear, streaking or seizure. Replace if necessary. Clean any oil or rust from flywheel surface with light abrasive. Check flywheel runout and replace if runout exceeds 0.005 in. (0.13 mm).
12. Inspect flywheel pilot bearing for wear or damage and replace if necessary.

Installing Clutch Disk and Pressure Plate

1. Apply a coating of grease to clutch disk spline, then use a brush to rub it in. Wipe off any excess grease.
2. Use clutch alignment tool (see Special Tools) to position clutch disk on flywheel.

3. Install pressure plate. Install and tighten six cap screws and lock washers a little at a time, working in a diagonal sequence. Torque screws from 5 to 7 ft-lb (7 to 9 N-m). Remove alignment tool from flywheel bearing.

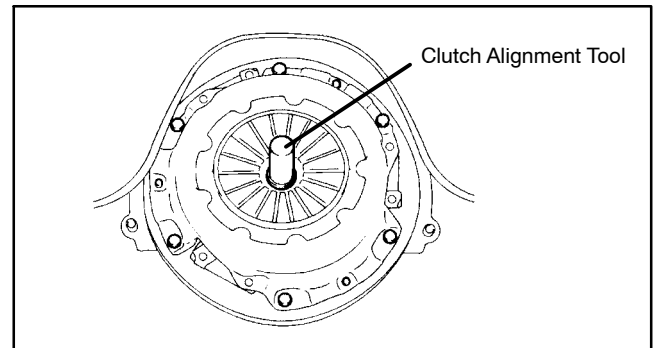


Figure 21

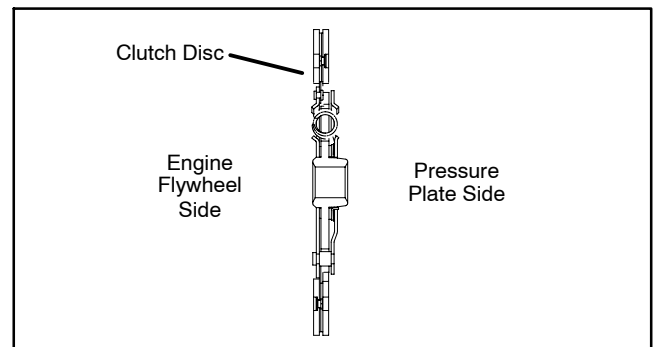


Figure 22

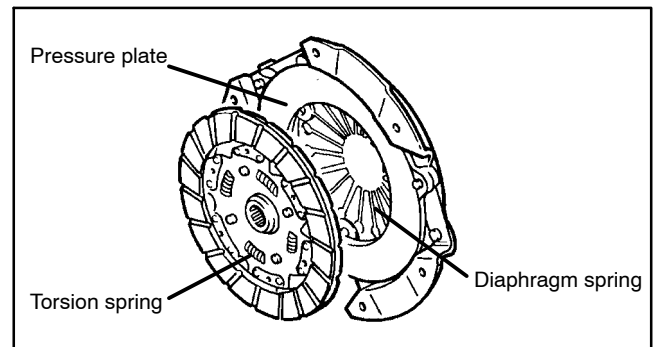


Figure 23

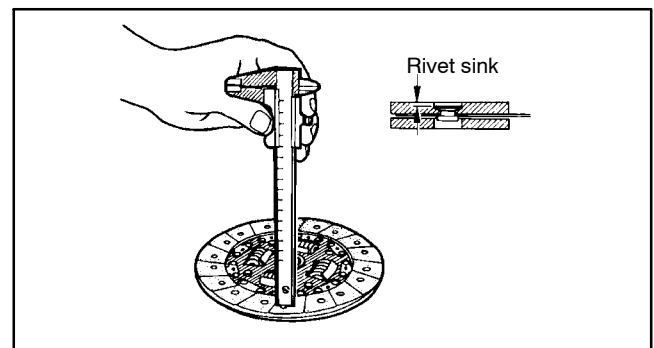


Figure 24

Transaxle Service

Disassembly

NOTE: Item numbers in figures are shown in order of disassembly; for example, remove Item 1 first, then Item 2, etc. Reassemble in reverse order; for example, install Item 1 last.

1. Remove extension spring (Item 1).
2. Loosen cap screws (Item 2) and remove bell housing assembly from transaxle.
3. Thoroughly clean outside surface of transaxle.

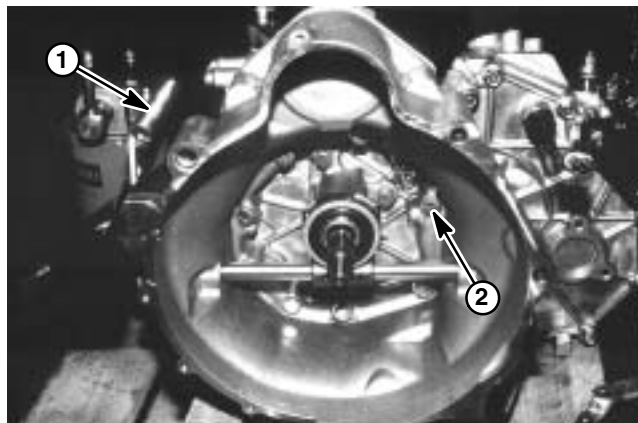


Figure 25

4. Loosen cap screws (Item 1) and remove fork shaft case (Item 2) from center plate. Note location of longer cap screw. Be careful when removing cover as steel balls inside are spring loaded.

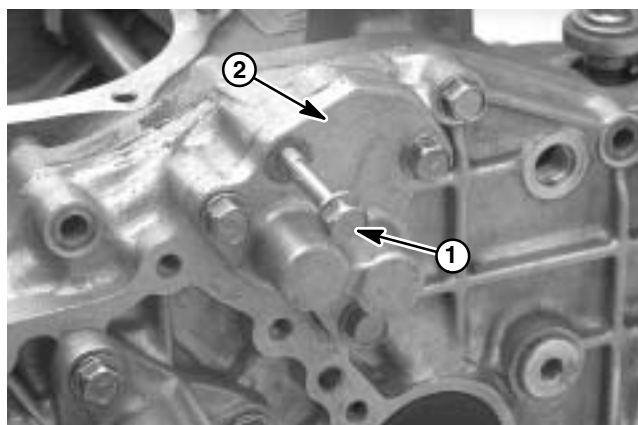


Figure 26

5. Hold your hand over the area and shift R-1 and 2-3 levers to move rails outward so balls (Item 3), springs (Item 2) and spindle (Item 1) can be removed.
6. Inspect fork shaft case for cracks or damage and replace if necessary.

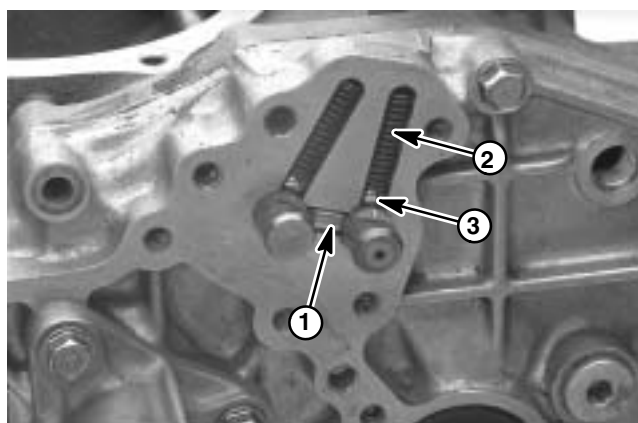


Figure 27

7. Loosen cap screws and separate center plate from transaxle case. Note dowel pins in transaxle case. Remove seal cap (Item 1), shims (Item 2 and 4) and snap ring (Item 3) from center plate.

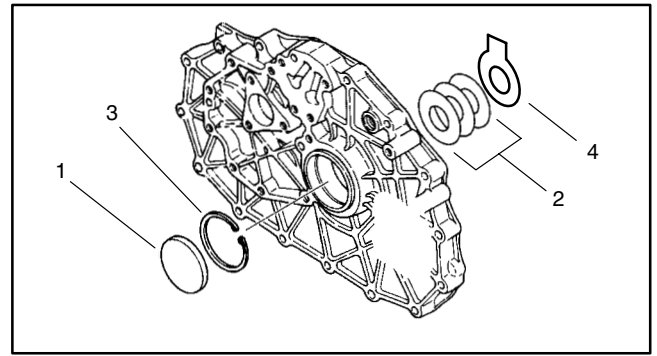


Figure 28

8. **On 4WD units**, remove front drive shaft and 41T gear from the gear case. Remove bearings from gear case (see Item 2 of Fig. 30) and center plate.

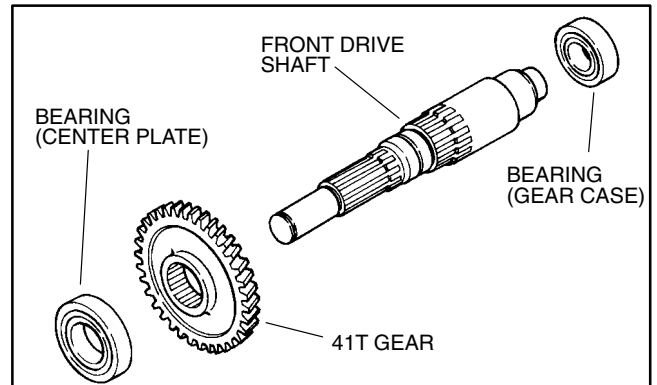


Figure 29

9. Remove reverse shaft (Item 1) from transaxle case.

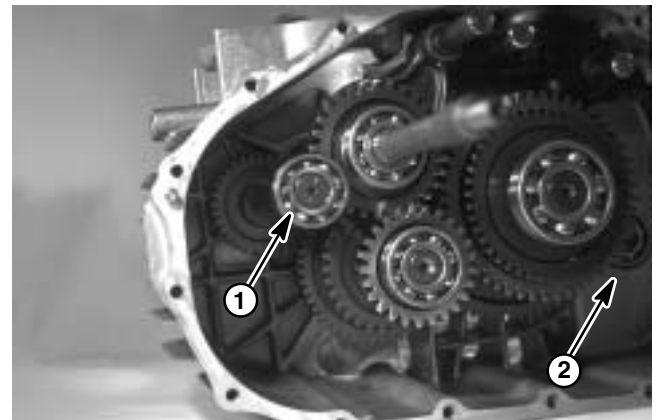


Figure 30

10. Remove main shaft assembly (Item 1) together with fork shaft assembly (Item 2) from transaxle case.

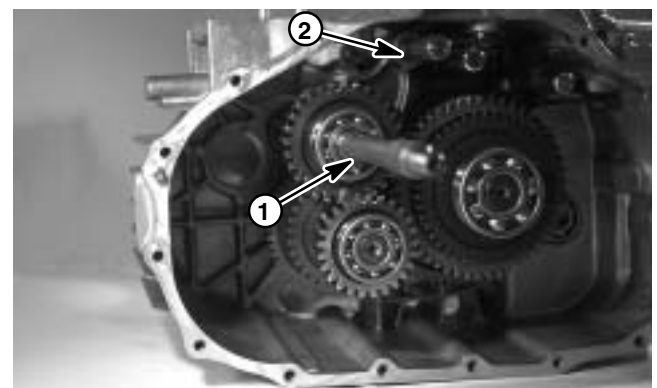


Figure 31

11.Remove, all at the same time, reduction shaft assembly (Item 1), 2nd–3rd shift assembly (Item 2), countershaft assembly (Item 3) and High–Low shift assembly (Item 4).

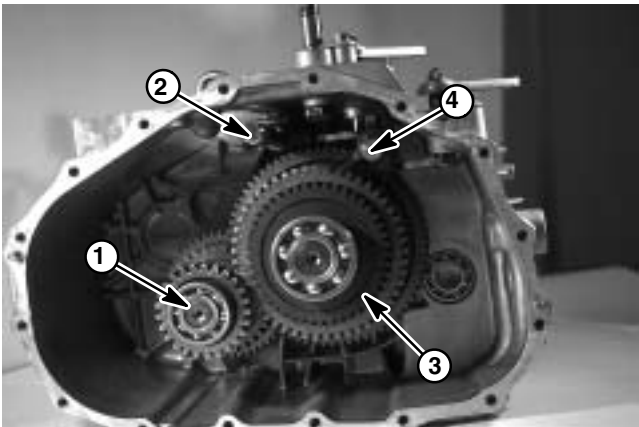


Figure 32

12.Loosen cap screws (Item 1) and remove L.H. axle shaft assembly (Item 2) and shims (Item 3) from L.H. side cover (Item 4) still attached to transaxle.

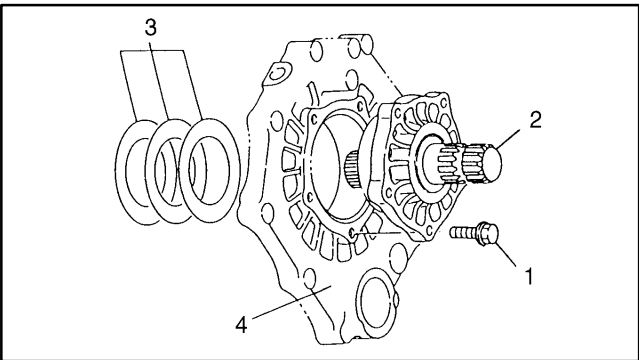


Figure 33

13.Remove roll pin from differential lock lever. Remove lever (Item 1) from shaft. Loosen cap screws (Item 2) and remove L.H. side cover (Item 3) from transaxle case.

14.Inspect side cover for cracks or damage and replace if necessary.

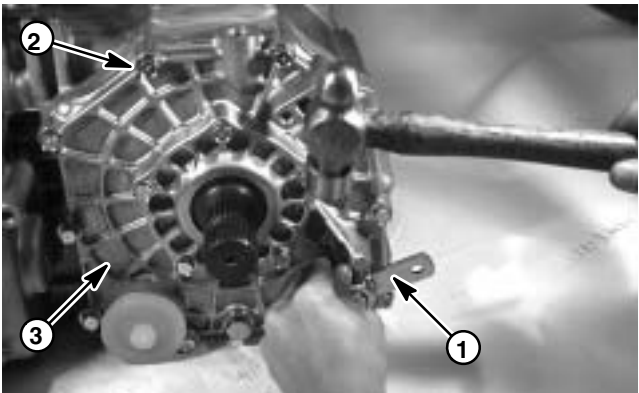


Figure 34

15.Loosen cap screws (Item 1) and remove R.H. axle shaft assembly (Item 2) from transaxle case.

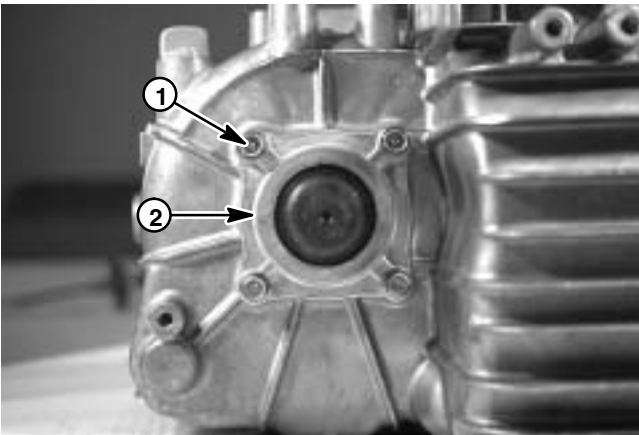


Figure 35
Workman 3000/4000 Series

16. Remove differential gear assembly (Item 1) together with fork shaft assembly (Item 2).

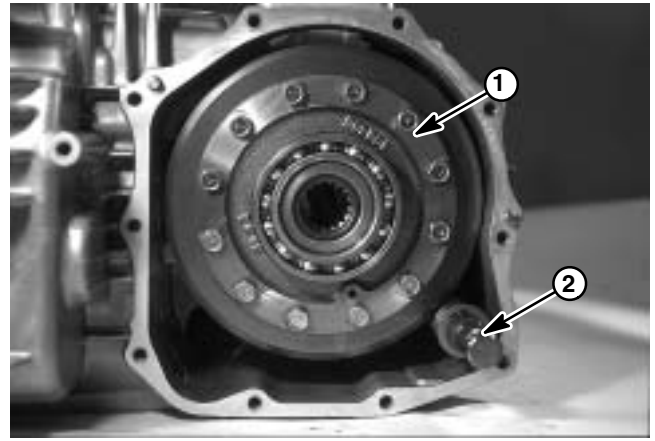


Figure 36

17. Remove washer (Item 1) from inside of transaxle case. NOTE: Washer may stick to fork shaft when removed in step 16.

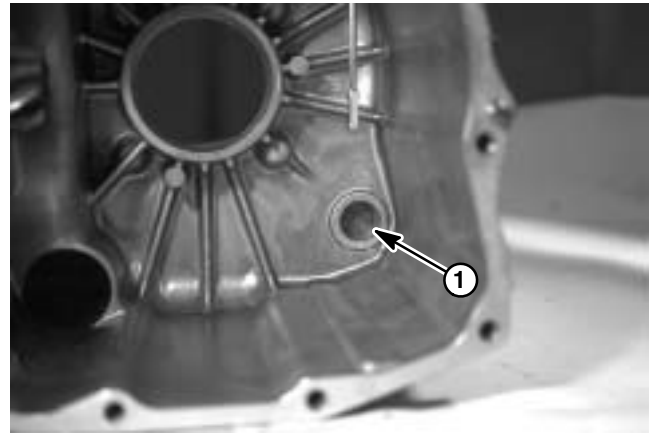


Figure 37

18. To remove shift arms:

A. Loosen and remove nut (Item 1). Remove washer (Item 2) and 2nd–3rd shift arm (Item 3) together with shift arm plate (Item 4), spring (Item 5), locknut (Item 6), washer (Item 7) and cap screw (Item 8).

B. Loosen and remove locknut (Item 9) and washer (Item 10) from both 1st–Rev. shift arm (Item 11) and High–Low shift arm (not shown). Remove shift arms.

C. Loosen cap screws (Fig. 39, Item 12) and remove keeper plates (Item 13).

D. Remove oil seals (Item 14).

E. Inspect shift arms and keeper plates for bending or damage and replace if necessary.

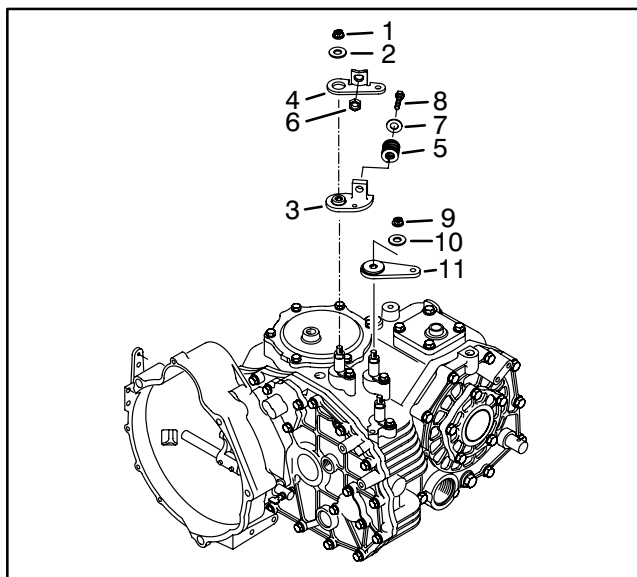


Figure 38

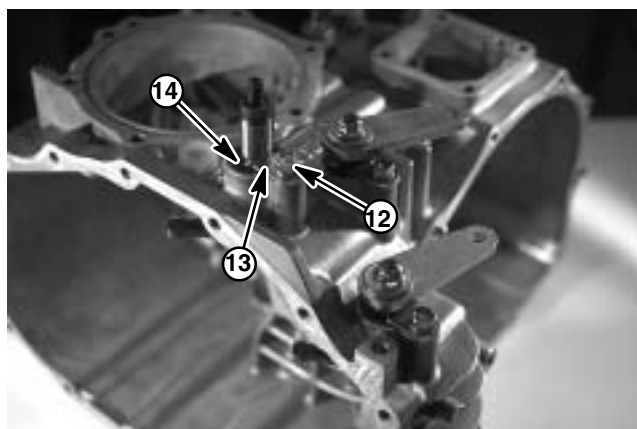


Figure 39

19. If P.T.O. cover is on transaxle, remove cap screws (Item 1) and nut (Item 2) with washer. Separate P.T.O. cover (Item 3) from transaxle case. Inspect P.T.O. cover for cracks or damage and replace if necessary.

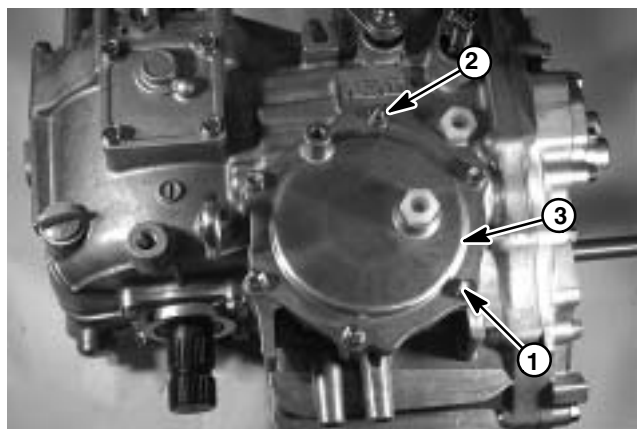


Figure 40

20. Remove oil cap (Item 1) and O-ring from transaxle case if necessary.

21. Remove air breather (Item 2) if necessary.

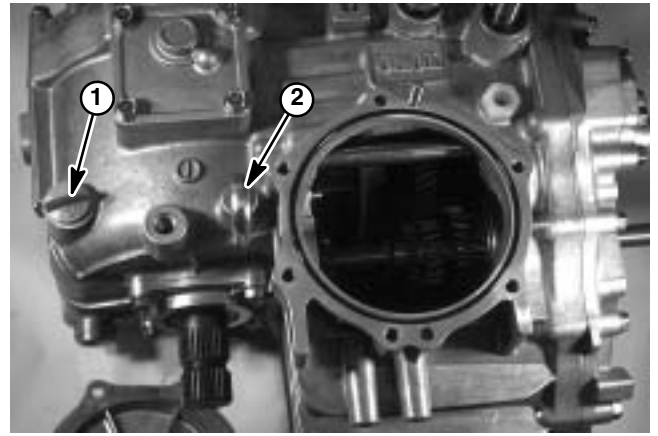


Figure 41

22. Loosen cap screws (Item 1) and remove upper cover (Item 2) from transaxle case.

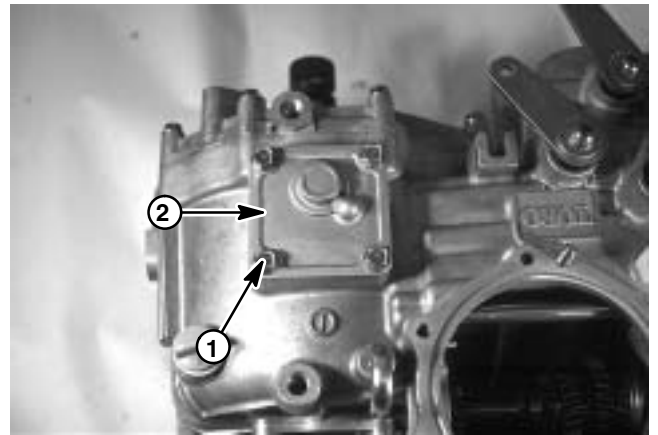


Figure 42

23. Disassemble main shaft assembly:

- A. Use a bearing puller to remove bearing (Item 1) from main shaft.
- B. Remove snap ring (Item 2) and washer (Item 3). Measure thickness of washer. Replace washer if it is less than .0709 in. (1.8 mm) thick.
- C. Remove 2 needle bearings (Item 5) and gear (Item 4). Inspect needle bearings and replace if necessary.
- D. Remove synchro ring (Item 6).
- E. Remove snap ring (Item 7).
- F. Remove shifter (Item 8) together with spring, hub and 3 keys.
- G. Remove key (Item 9).
- H. Remove snap ring (Item 10).
- I. Remove synchro ring (Item 6), gear (Item 11), 2 needle bearings (Item 12) and washer (Item 13). Inspect needle bearings and replace if necessary.
- J. Use a bearing puller to remove bearing (Item 14).
- K. Remove gear (Item 15), snap ring (Item 16), gear (Item 17) and gear (Item 18).

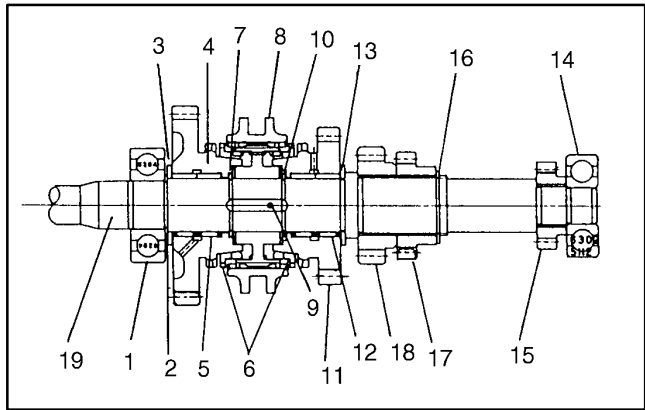


Figure 43

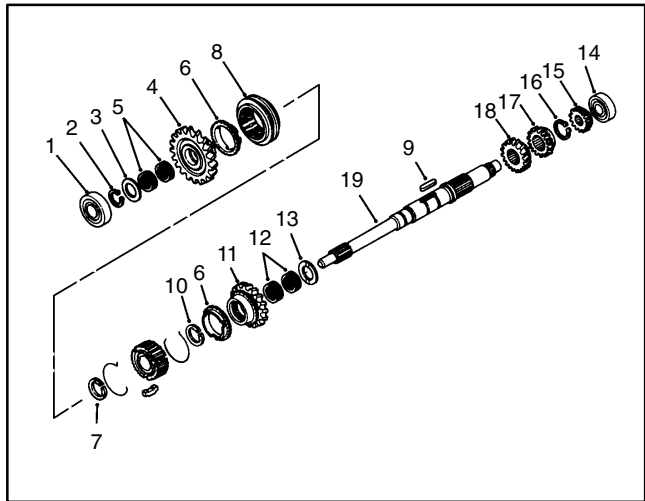


Figure 44

24. Disassemble reduction shaft assembly:

- A. Use a bearing puller to remove bearing (Item 1) from reduction shaft.
- B. Remove gear (Item 2), helical gear (Item 3), collar (Item 4) and gear (Item 5).
- C. Use a bearing puller to remove bearing (Item 6).
- D. Remove washer (Item 7), needle bearing (Item 9) and gear (Item 8).
- E. Remove spacer (Item 10).
- F. Remove snap ring (Item 11).
- G. Remove shifter (Item 12) together with spring, hub and 3 keys.
- H. Remove key (Item 13).
- I. Remove synchro ring (Item 14) from gear (Item 15).
- J. Remove gear (Item 15), needle bearing (Item 16) and thrust washer (Item 17). Inspect needle bearing and replace if necessary. Measure thickness of thrust washer. Replace thrust washer if thickness is less than .0709 in. (1.8 mm).

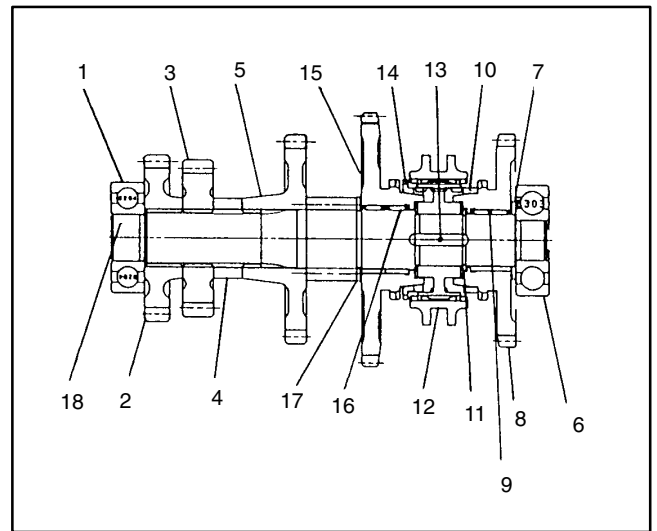


Figure 45

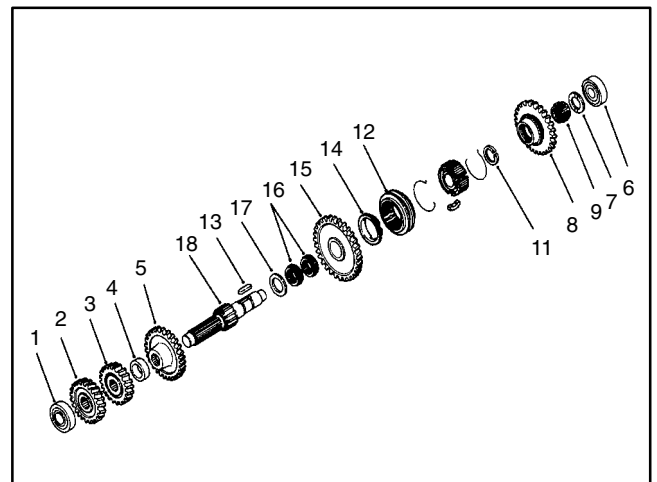


Figure 46

25. Disassemble reverse shaft assembly:

- A. Use a bearing puller to remove bearing (Item 1) from reverse shaft.
- B. Remove gear (Item 2).
- C. Use a bearing puller to remove bearing (Item 3) from reverse shaft.

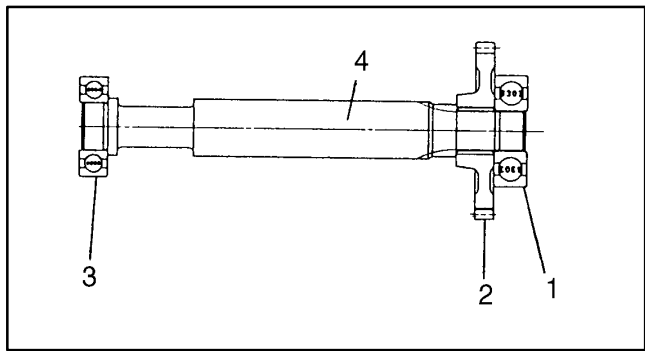


Figure 47

26. Disassemble countershaft assembly:

- A. Use a bearing puller to remove bearing (Item 1) from countershaft.
- B. Remove thrust washer (Item 2) and snap ring (Item 3).
- C. Remove thrust washer (Item 4) and gear (Item 5).
- D. Remove inner (Item 6) and thrust washer (Item 7). Inspect inner for wear and damage. Replace inner if O.D. is less than 1.258 in. (31.95 mm). Measure thickness of thrust washer. Replace thrust washer if thickness is less than .0709 in. (1.8 mm).
- E. Remove 2 snap rings (Item 8).
- F. Remove Hi-Lo shifter (Item 9) and collar spline (Item 10).
- G. Remove gear (Item 11). Inspect bushing for wear and damage. Replace gear if I.D. exceeds 1.184 in. (30.08 mm).
- H. Remove washer (Item 12), snap ring (Item 13) and collar (Item 14). Measure thickness of washer and replace washer if thickness is less than .110 in. (2.8 mm)
- I. Use a bearing puller to remove 2 bearings (Item 15).

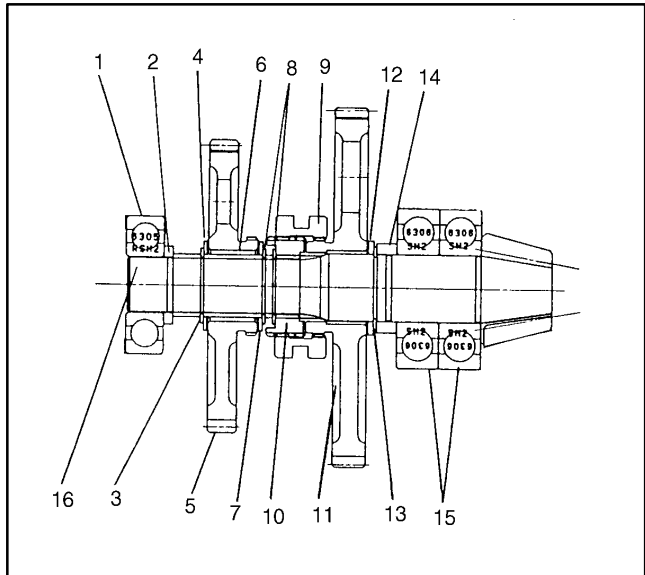


Figure 48

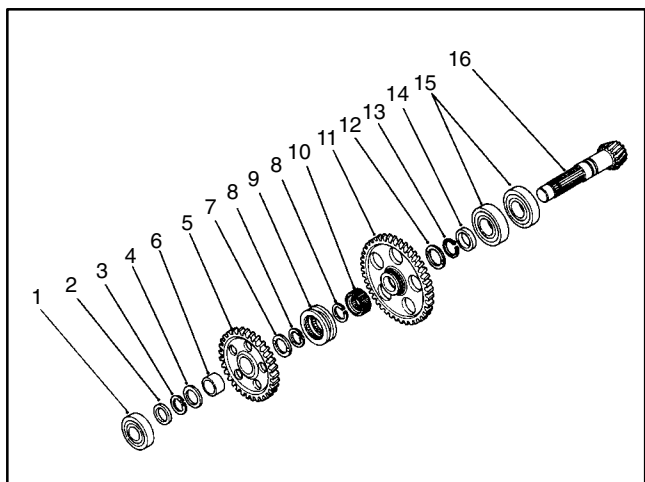


Figure 49

27. Disassemble fork shaft assemblies:

- A. Remove lock pin (Item 1) from 2nd–3rd fork shaft assembly.
- B. Remove shift fork (Item 2) from fork shaft.
- C. Remove lock pin (Item 1) from 1st–R fork shaft assembly.
- D. Remove fork (Item 2) from fork shaft.

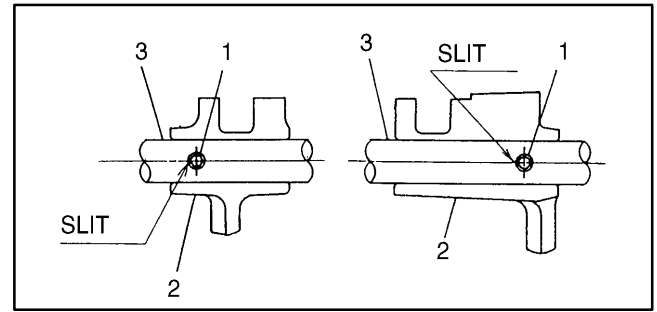


Figure 50

28. Disassemble Hi–Lo fork shaft assembly:

- A. Remove shift fork (Item 1), steel ball (Item 2) and spring (Item 3) from Hi–Lo shift fork assembly.
- B. Remove E–ring (Item 4).

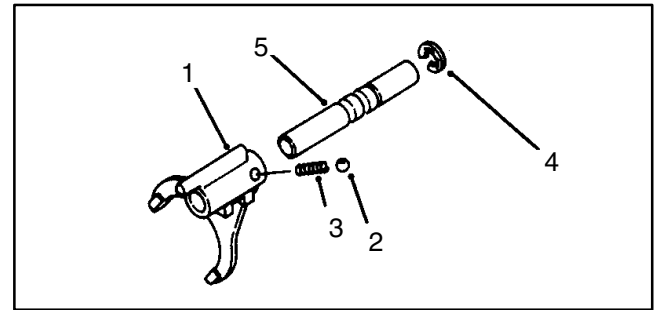


Figure 51

29. Disassemble differential gear assembly:

- A. Use a bearing puller to remove bearing (Item 1) from differential case.
- B. Remove snap ring (Item 2).
- C. Use a bearing puller to remove bearing (Item 3) and slider (Item 4).
- D. Loosen screws (Item 5) from ring gear.
- E. Remove ring gear (Item 6) from differential case and remove 2 dowel pins (Item 7).
- F. Drive lock pin (Item 8) out of pinion shaft (Item 9).
- G. Remove pinion shaft (Item 9) from differential case.
- H. Remove 2 differential pinions (Item 10) and 2 liners (Item 11).
- I. Remove L.H. side gear (Item 12), R.H. side gear (Item 13) and 2 liners (Item 14).

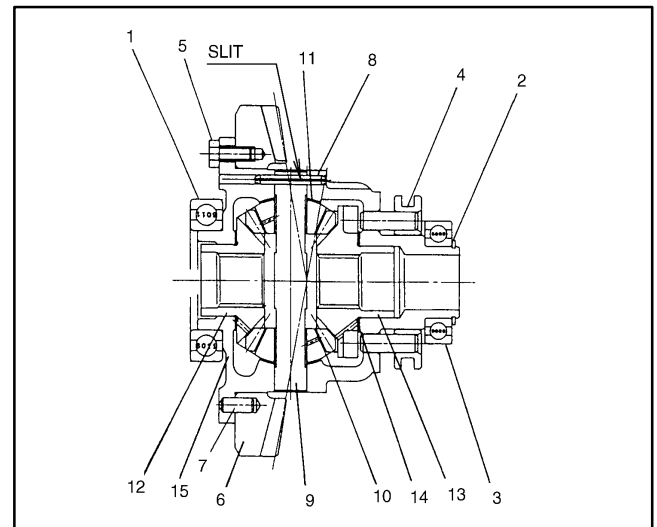


Figure 52

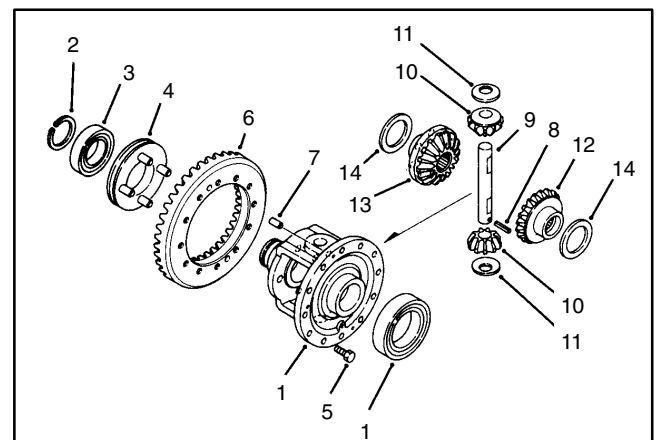


Figure 53

30. Disassemble differential fork shaft assembly:

- A. Remove O-ring (Item 1) from fork shaft.
- B. Remove snap ring (Item 2), washer (Item 3) and spring (Item 4).
- C. Remove fork (Item 5).
- D. Remove lock pin (Item 6) if necessary.

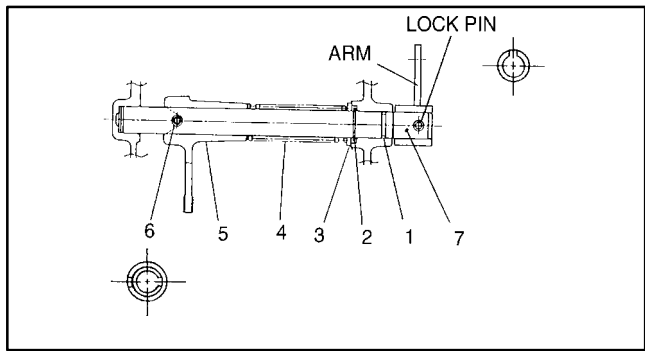


Figure 54

31. Disassemble axle shaft assemblies:

- A. Remove O-ring (Item 1) from differential carrier.
- B. Remove snap ring (Item 2).
- C. Remove L.H. axle shaft assembly (Item 3).
- D. Remove snap ring (Item 4) and washer (Item 5).
- E. Use a bearing puller to remove bearing (Item 6) from axle shaft.
- F. Remove oil seal (Item 7) from differential carrier (Item 8).
- G. Remove R.H. axle shaft assembly (Item 1) from seal cover.
- H. Remove snap ring (Item 2) and washer (Item 3) from axle shaft.
- I. Use a bearing puller to remove bearing (Item 4).
- J. Remove oil seal (Item 5) from seal cover.

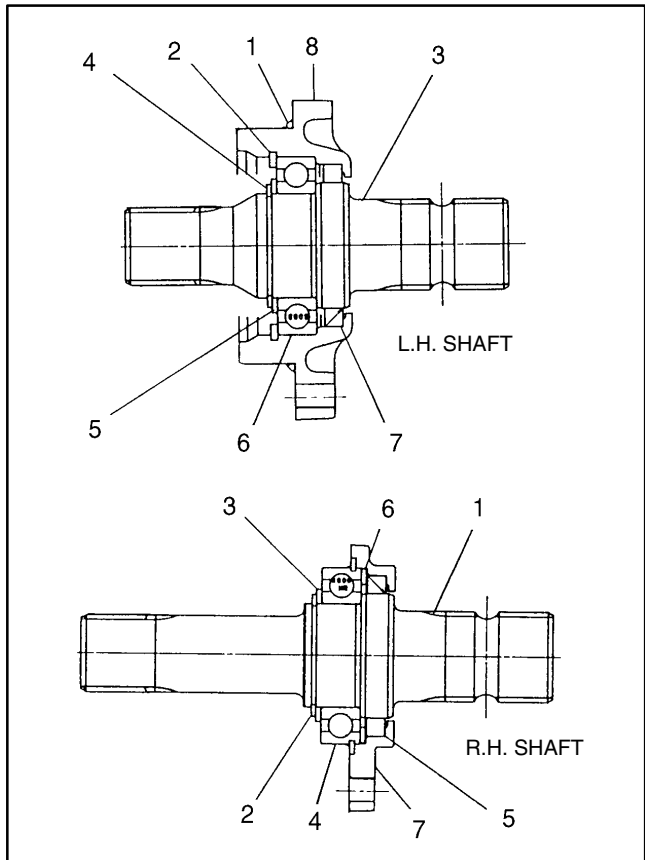


Figure 55

Inspection

1. Thoroughly clean and dry all parts.
2. Use emery cloth to remove nicks and burrs from all parts.
3. Inspect synchronizer ring:
 - A. Inspect the chamfer for excessive wear or damage.
 - B. Inspect inner tapered area for excessive wear or damage.
 - C. Measure the clearance between synchronizer ring and synchro gear in three equally spaced points. If clearance is less than .0195 in. (0.5 mm) replace the synchronizer ring.
4. Inspect synchro gears:

- A. Inspect the cone surface for roughness, material transfer (brass color material) or damage.
- B. Inspect the spline chamfer for excessive chipping or damage.
- C. Inspect I.D. of synchro gear for excessive wear or scoring. If synchro gears have the following I.D., replace the synchro gear:

22T, 25T, 40T	I.D. exceeds 1.027 in. (26.08 mm)
49T	I.D. exceeds 1.145 in. (29.08 mm)

5. **On 4WD units**, inspect 41T gear and front drive shaft (Fig. 57):

- A. Inspect gear teeth for roughness, material transfer (brass color material) or damage.
- B. Inspect spline chamfer for excessive chipping or damage.
- C. Inspect I.D. of gear for excessive wear or scoring. Gear should fit snugly on shaft.



Figure 56

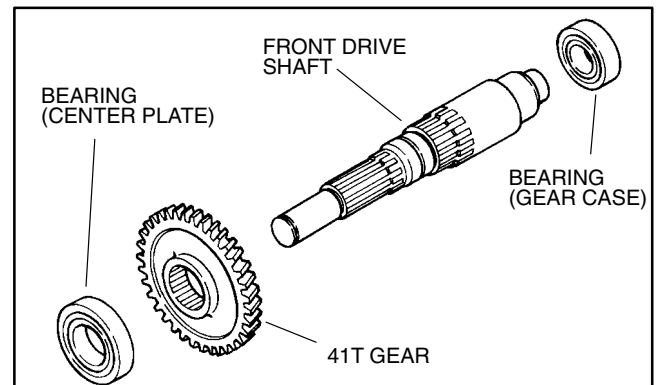


Figure 57

6. Inspect hub, shifter, synchro key and synchro spring:

- A. Inspect hub for worn or damaged spline.
- B. Inspect shifter for chipping or damaged chamfer.
- C. Inspect synchro keys for wear or damage.
- D. Inspect synchro springs for wear or damage.
- E. The shifter should move freely on the hub.
- F. Measure the clearance between shifter groove and fork. Replace shift fork, if the clearance exceeds .039 in. (1.0 mm).

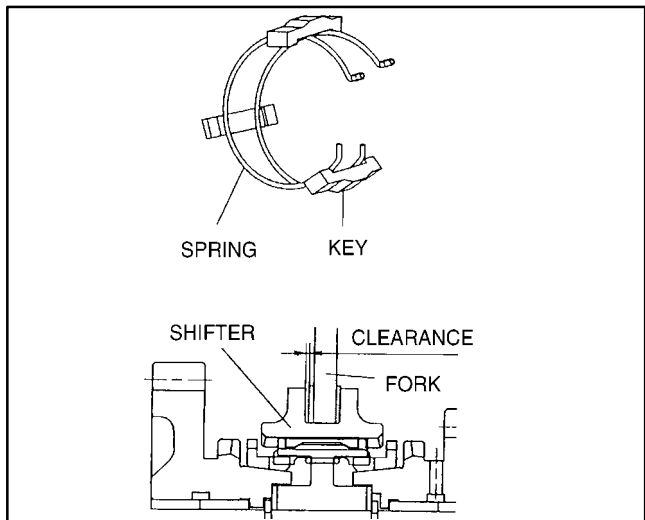


Figure 58

7. Inspect main shaft:

- A. Inspect main shaft for worn or damaged surface. If O.D. of needle bearing surface is less than .864 in. (21.95 mm), replace the main shaft.
- B. Inspect lip portion of oil seal for wear or damage.
- C. Insert spline in clutch disk and check for excessive looseness and free sliding of clutch disk hub.

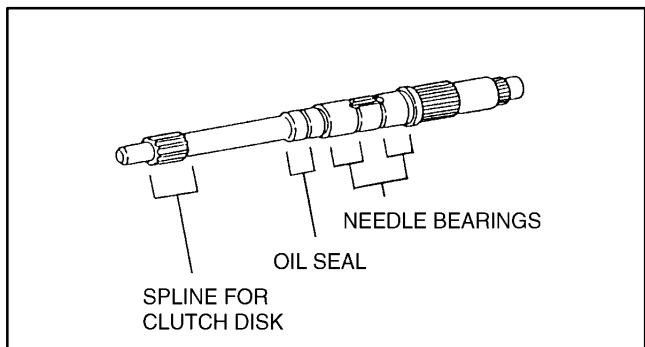


Figure 59

8. Inspect both snap ring (item 3) and shim(s) (items 2 and 4) for damage. Replace all parts if any part is cracked or broken (Fig. 60).

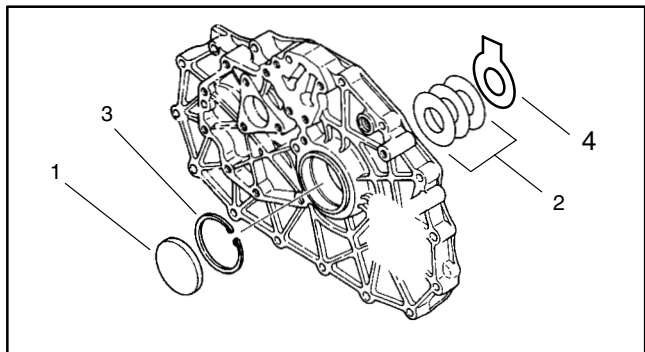


Figure 60

9. Inspect center plate for cracks and damage. Replace center plate if the snap ring groove has more than 15% of its edges damaged due to nicks, rounding, cracks, or dents (Fig. 61 and 62).



Figure 61

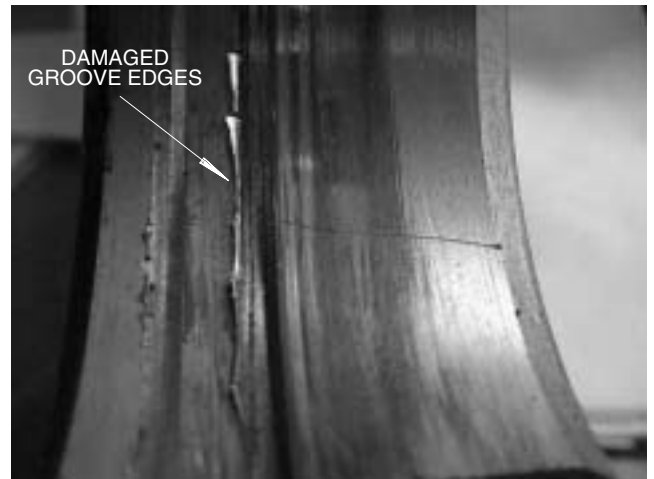


Figure 62

10. Inspect reduction shaft for wear or damage. If O.D. of needle bearing area is less than .864 in. (21.95 mm) or .982 in. (24.95 mm), replace the reduction shaft.

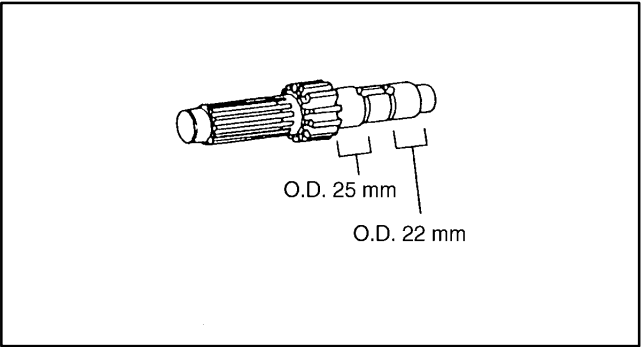


Figure 63

11. Inspect countershaft for wear or damage. If O.D. of inner portion is less than 1.100 in. (27.95 mm) or 71T gear portion is less than 1.179 in. (29.95 mm), replace the countershaft.

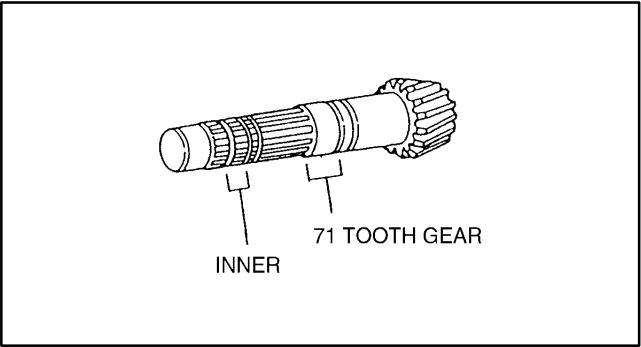


Figure 64

12. Inspect differential:

- A. Inspect pinion shaft for excessive wear or damage. If O.D. is less than .707 in. (17.95 mm), replace the pinion shaft.
- B. Measure thickness of pinion liners. If thickness is less than .035 in. (0.9 mm), replace the pinion liners.
- C. Measure thickness of side gear liners. If thickness is less than .043 in. (1.1 mm), replace the side gear liners.
- D. Inspect the gear contact condition between spiral bevel pinion and ring gear.
- E. Inspect differential case for wear in side gears and pinion shaft mating area. Replace the case if machined surfaces are scored or if the pinion shaft fits loosely in the bore.

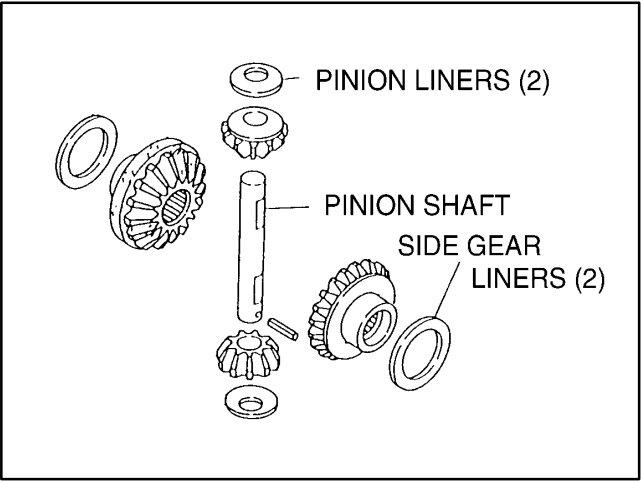


Figure 65

Assembly

NOTE: Item numbers in figures are shown in reverse order of assembly; for example, when reassembling, install Item 1 last.

1. Clean gasket material from all mating surfaces before reassembling. Make sure all parts are clean and free of dirt and dust.

IMPORTANT: Be careful not to damage mating surfaces when removing gasket material.

2. Assemble L.H. axle shaft:

- A. Install new oil seal (Item 7) into differential carrier.
- B. Use a press to install bearing (Item 6) onto L.H. axle shaft.
- C. Install washer (Item 5) and snap ring (Item 4).
- D. Install L.H. axle shaft assembly into differential carrier.
- E. Install snap ring (Item 2).
- F. Install new O-ring (Item 1). Apply multi-purpose grease on O-ring before installing.

3. Assemble R.H. axle shaft:

- A. Install new oil seal (Item 5) into seal cover. Apply multi-purpose grease on O-ring before installing.
- B. Insert washer (Item 6).
- C. Use a press to install bearing (Item 4) onto R.H. axle shaft.
- D. Install washer (Item 3) and snap ring (Item 2).
- E. Install R.H. axle shaft assembly into seal cover (Item 7).

4. Assemble differential fork shaft:

- A. Drive 2 lock pins (Item 6) into fork shaft (Item 7). Make sure lock pins are installed with slit facing the correct direction.
- B. Install fork (Item 5), spring (Item 4), washer (Item 3) and snap ring (Item 2) onto fork shaft using a press. Apply moly disulfide grease onto fork portion of fork shaft before installing.
- C. Install new O-ring (Item 1). Apply multi-purpose grease on O-ring before installing.

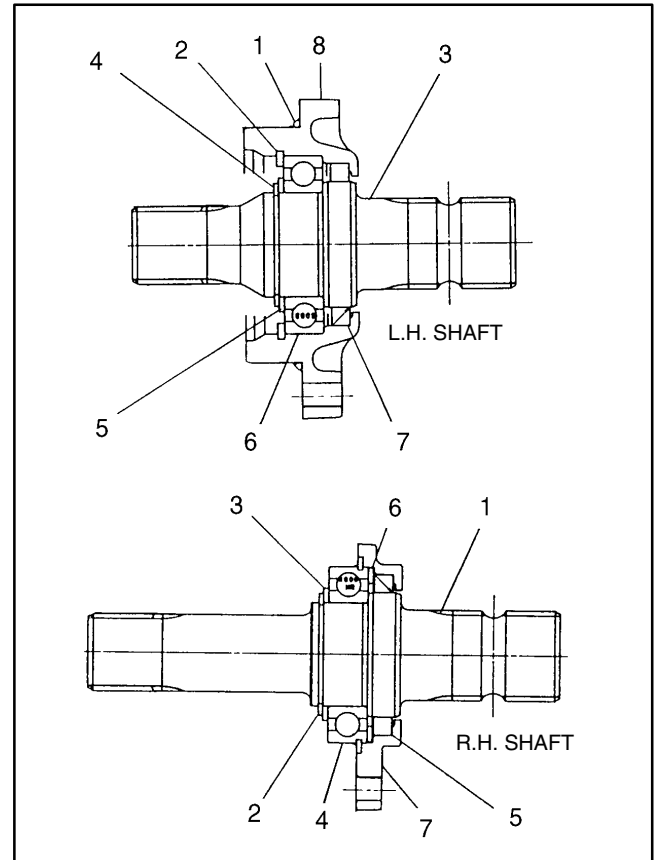


Figure 66

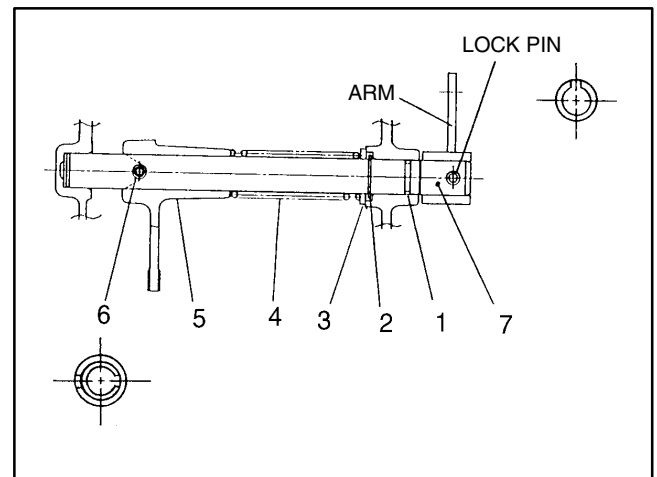


Figure 67

5. Assemble differential gears:

A. Apply moly disulfide grease on pinion liners (Item 11), holes of pinion gears (Item 10), side gear liners (Item 14) and hubs of side gears (Item 13, 12).

B. Install side gear liners (Item 14), side gears (Item 13, 12), pinion liners (Item 11) and pinion gears (Item 10).

C. Rotate side gears until holes of pinion gears and liners line up with holes of differential case (Item 1).

D. Insert pinion shaft (Item 9). Grease the shaft to aid assembly.

E. Assemble lock pin (Item 8). Drive the pin to the approximate center location of the pinion mate shaft. Pay attention to direction of slit in lock pin.

F. Check for smooth revolution of pinion gears and side gears.

G. Completely clean oil from threads in ring gear (Item 6).

NOTE: Ring gear and countershaft are supplied in matched sets only.

H. Insert 2 dowel pins (Item 7) onto ring gear (Item 6).

I. Completely clean oil from threads of cap screws (Item 5).

NOTE: It is recommended that whenever the ring gear screws are removed that they be replaced with new screws.

J. Apply Loctite to threads of cap screws.

K. Clean oil from contact surface of differential case and ring gear.

L. Drive ring gear onto differential case.

M. Tighten cap screws to a torque from 18.5 to 22 ft-lb (24.5 to 29.5 N-m).

N. Use a press to install bearing (Item 1) onto differential case.

O. Install slider (Item 4). Put moly disulfide grease onto sliding area of differential case before installing.

P. Use a press to install bearing (Item 3).

Q. Install snap ring (Item 2).

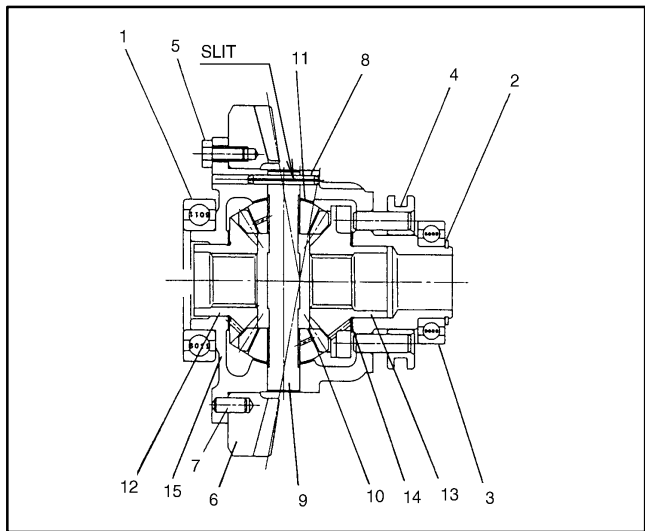


Figure 68

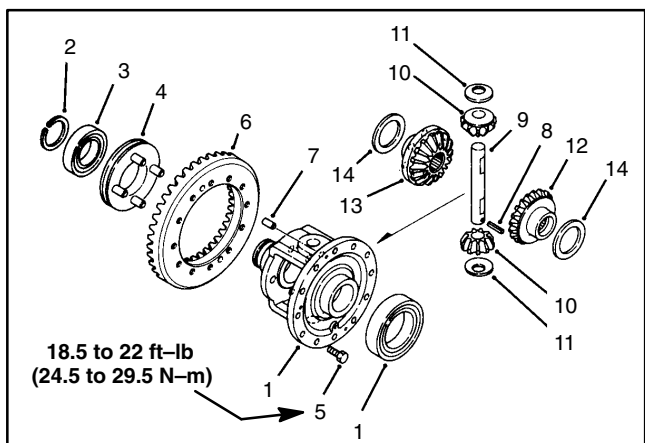


Figure 69



Figure 70



Figure 71

6. Assemble Hi-Lo fork shaft:

- A. Install E-ring (Item 4) onto fork shaft (Item 5).
- B. Insert spring (Item 3) and steel ball (Item 2) into fork (Item 1).
- C. Insert fork shaft into fork. Put moly disulfide grease onto the shaft before installing.

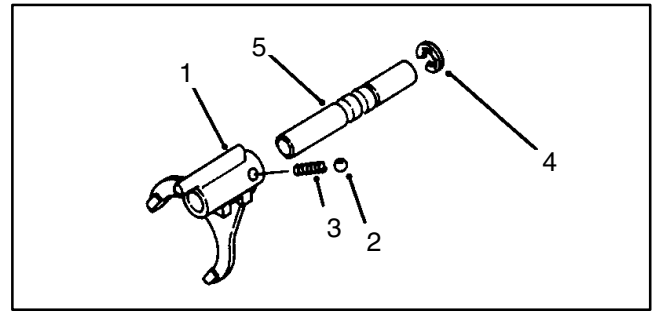


Figure 72

7. Assemble R-1 and 2-3 fork shaft:

- A. Insert R-1 fork shaft (Item 2) into R-1 fork (Item 3).
- B. Drive lock pin (Item 1) into fork and fork shaft. Pay attention to direction of slit in lock pin.
- C. Insert 2-3 fork shaft (Item 2) into 2-3 fork (Item 3).
- D. Drive lock pin (Item 1) into fork and fork shaft. Pay attention to direction of slit in lock pin.

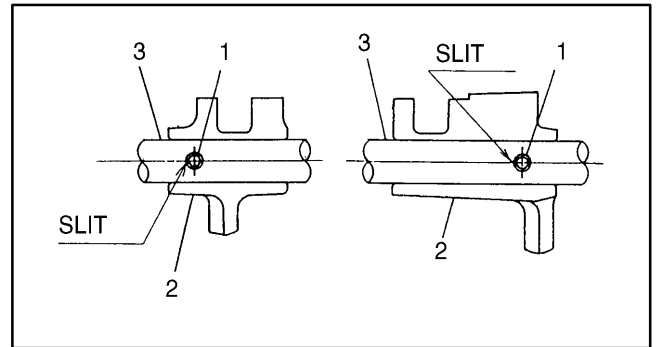


Figure 73

8. Assemble countershaft:

A. Use a press to install 2 new bearings (Item 15) onto countershaft.

B. Install collar (Item 14) and snap ring (Item 13).

C. Install washer (Item 12) and gear (Item 11). Apply moly disulfide grease into bushing of countershaft gear before installing. Oil groove on washer must face the gear.

D. Install collar-spline (Item 10) and snap ring (Item 8).

E. Install shifter (Item 9) onto collar-spline.

F. Install snap ring (Item 8), washer (Item 7) and inner (Item 6). Oil groove on washer must face the gear.

G. Install gear (Item 5).

H. Install washer (Item 4) and snap ring (Item 3). Oil groove on washer must face the gear.

I. Install washer (Item 2) and a new bearing (Item 1) using a press.

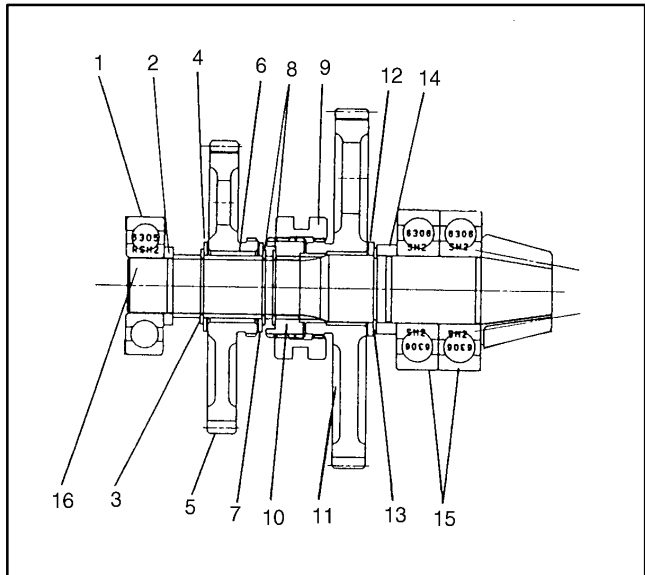


Figure 74

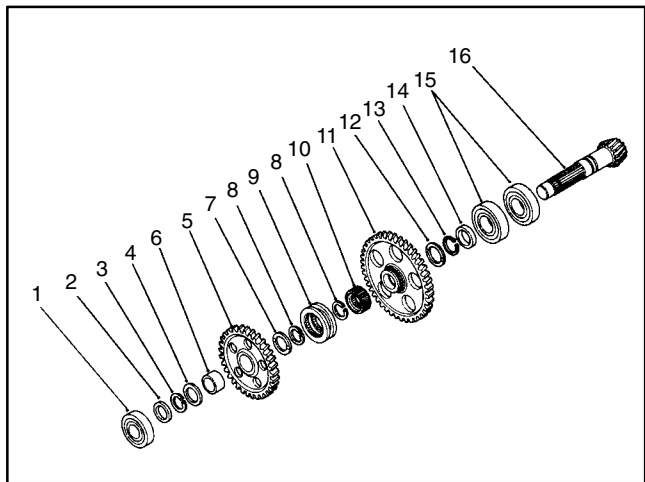


Figure 75

9. Assemble synchro hub:

A. Install 3 keys (Item 1) into grooves of hub (Item 2).

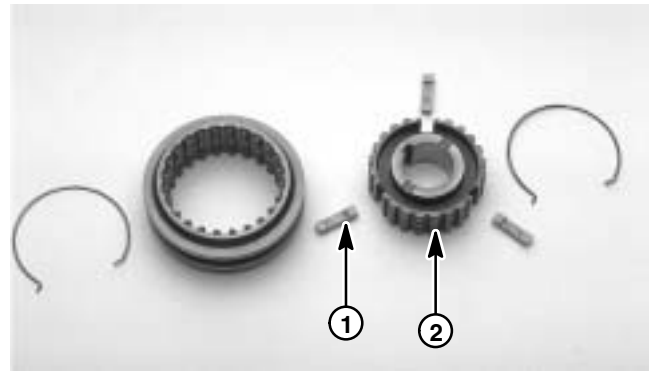


Figure 76

B. Install shifter (Item 1) onto hub (Item 2).

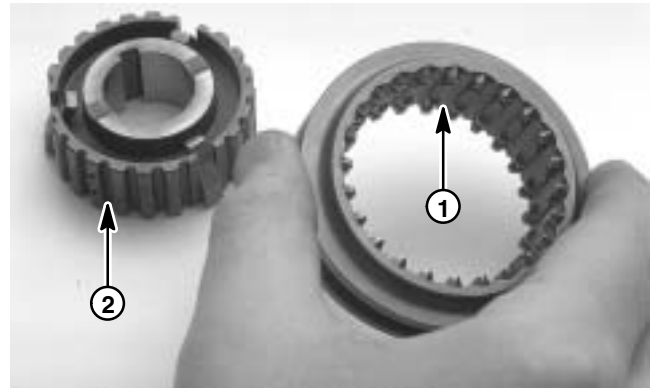


Figure 77

C. Insert 2 springs (Item 3) into hub. Pay attention to direction of spring.

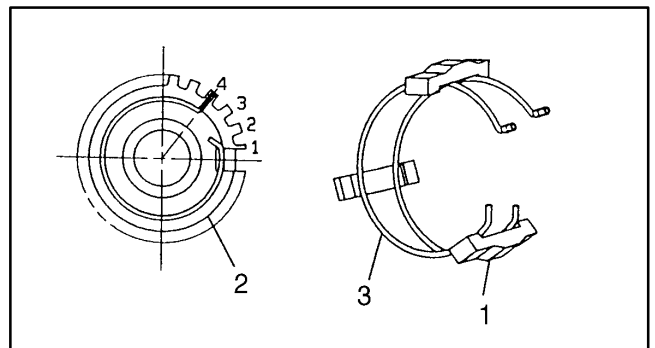


Figure 78



Figure 79

10. Assemble reduction shaft:

- A. Install washer(s) (Item 17), 2 needle bearings (Item 16) and gear (Item 15) onto reduction shaft (Item 18). Apply moly disulfide grease to washer and needle bearings before installing. Oil groove on washer must face the gear.
- B. Install synchro ring (Item 14) onto gear (Item 15). Apply Dexron III transmission oil on cone face of gear before installing synchro ring.
- C. Insert key (Item 13) onto reduction shaft.
- D. Install synchro hub sub-assembly (Item 12).
- E. Install snap ring (Item 11).
- F. Install spacer (Item 10) onto gear (Item 8).
- G. Insert needle bearings (Item 9) into gear (Item 8).
- H. Install washer (Item 7). Oil groove on washer must face the gear.
- I. Use a press to install bearing (Item 6).

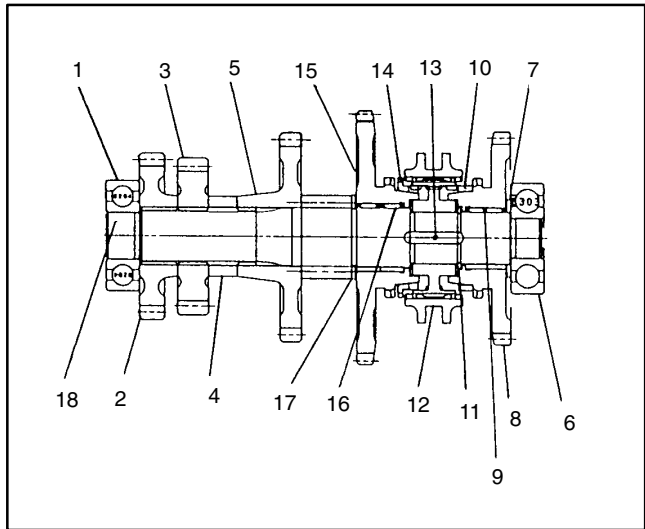


Figure 80

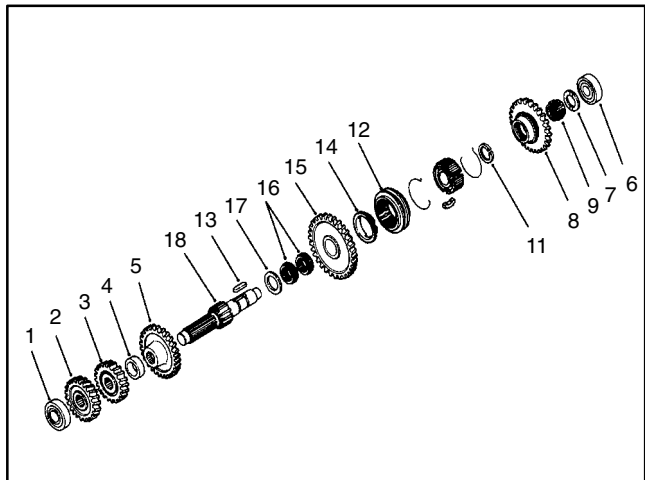


Figure 81

11. Assemble reverse shaft:

- A. Install gear (Item 2) onto reverse shaft.
- B. Use a press to install bearings (Item 3 and 1).

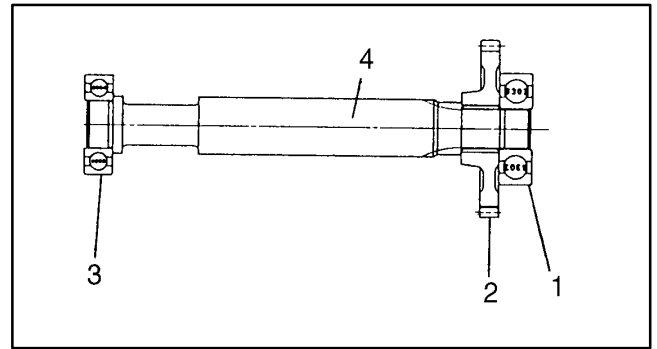


Figure 82

12. Assemble main shaft:

- A. Install gear (Item 18), gear (Item 17) and snap ring (Item 16).
- B. Install gear (Item 15).
- C. Use a press to install bearing (Item 14).
- D. Install washer (Item 13) and 2 needle bearings (Item 12) onto main shaft. Apply moly disulfide grease onto washer and needle bearings before installing. Oil groove on washer must face the gear.
- E. Install gear (Item 11) and snap ring (Item 10).
- F. Install synchro ring (Item 6) onto gear (Item 11). Apply Dexron III transmission oil on cone face of gear before installing synchro ring.
- G. Insert key (Item 9).
- H. Install synchro hub sub-assembly (Item 8).
- I. Install snap ring (Item 7).
- J. Install synchro ring (Item 6) onto gear (Item 4). Apply Dexron III transmission oil to cone face of gear before installing synchro ring.
- K. Insert 2 needle bearings (Item 5) into gear (Item 4). Apply moly disulfide grease onto needle bearings before installing.
- L. Install gear (Item 4) with synchro ring onto main shaft.
- M. Install washer (Item 3) and snap ring (Item 2). Apply moly disulfide grease to washer before installing. Oil groove on washer must face the gear.

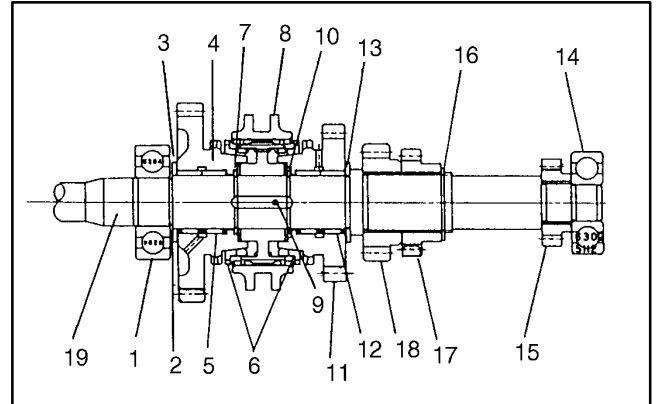


Figure 83

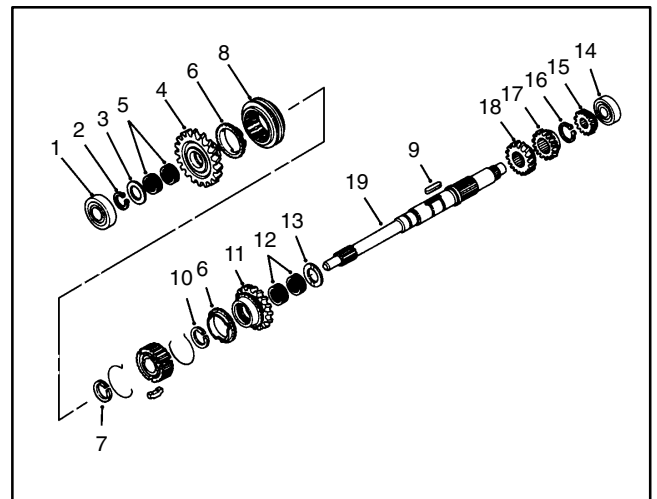


Figure 84

13. Assemble shift arms:

A. Install 3 new oil seals (Item 14) onto transaxle case. Apply multi-purpose grease on lips of oil seals before installing.

B. Install 3 keeper plates (Item 13) and tighten 3 cap screws (Item 12) to a torque from 11 to 13 ft-lb (15 to 17 N-m).

C. Apply Loctite #680 (or equivalent) to threads and tapers of shift fork arms.

D. Install 2 shift arms (Item 11). Install shift arm assembly (Items 8, 7, 6, 5, 4, 3).

E. Install washers (Items 10 and 2) and locknuts (Items 9 and 1). Tighten shift arm retaining locknuts to a torque from 200 to 280 in-lb (22.6 to 31.6 N-m).

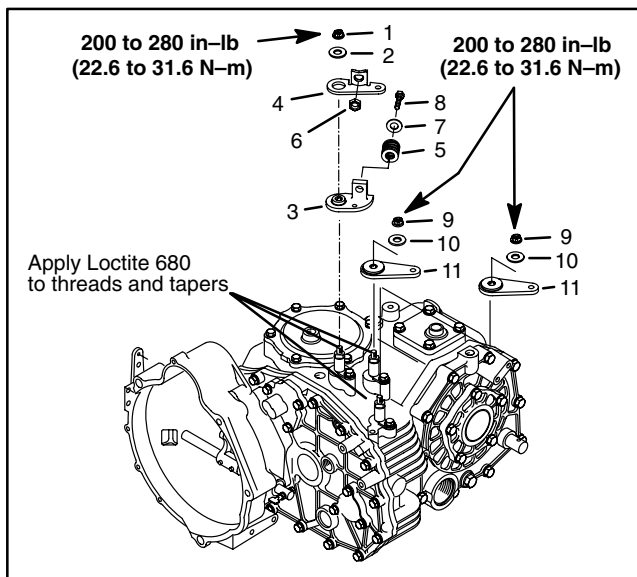


Figure 85

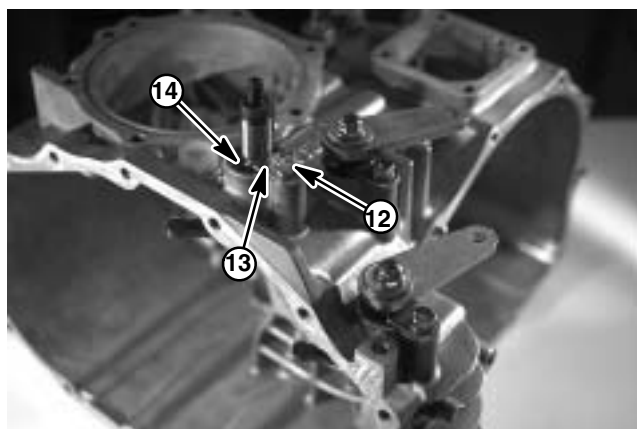


Figure 86

14. Install oil cap (Item 1) with O-ring. Apply multi-purpose grease to O-ring.

15. If removed, install air breather (Item 2). Use sealing tape on threads of air breather.

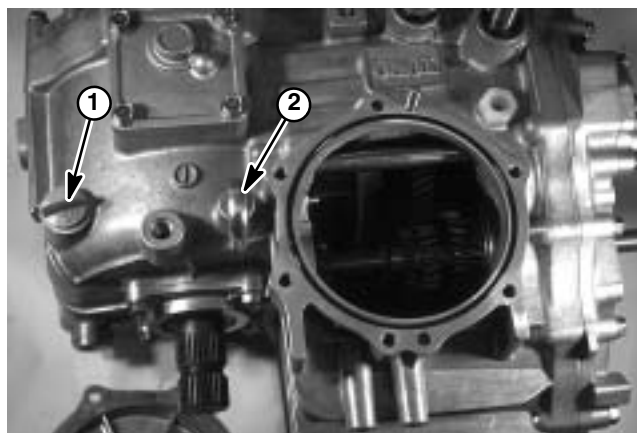


Figure 87

16. Install reduction shaft and countershaft together with R-1 fork shaft and Hi-Lo fork shaft. Insert heads of shift arms into grooves of forks when installing them.



Figure 88

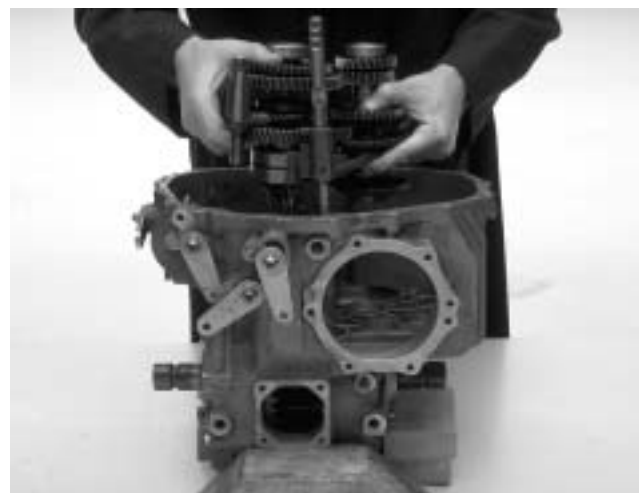


Figure 89

17. Install main shaft together with 2-3 fork shaft. Insert head of shift arm into groove of fork while installing.



Figure 90



Figure 91

18. Install reverse shaft (Item 1). Rotate main shaft and reverse shaft gears to mesh gears when installing.

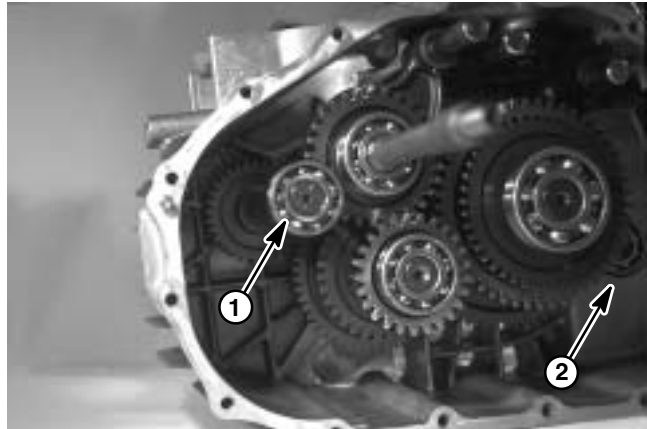


Figure 92

19. **On 4WD vehicles**, install bearing to gear case (see Item 2 of Fig. 92) and center plate. Install front drive shaft and 41T gear to the gear case.

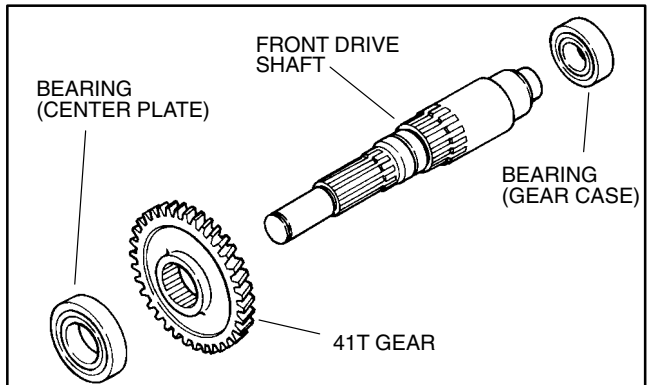


Figure 93

20. Install center plate:

- A. Insert 2 dowel pins into transaxle case.
- B. Apply silicone sealant onto mating surface of center plate.
- C. Position center plate to transaxle.
- D. Install and tighten cap screws to a torque from 18.5 to 22 ft-lb (24.5 to 29.5 N-m).
- E. Apply multi-purpose grease onto lips of oil seal, then insert oil seal flush with face of housing.
- F. Apply moly disulfide grease to spline of main shaft for clutch disk hub.

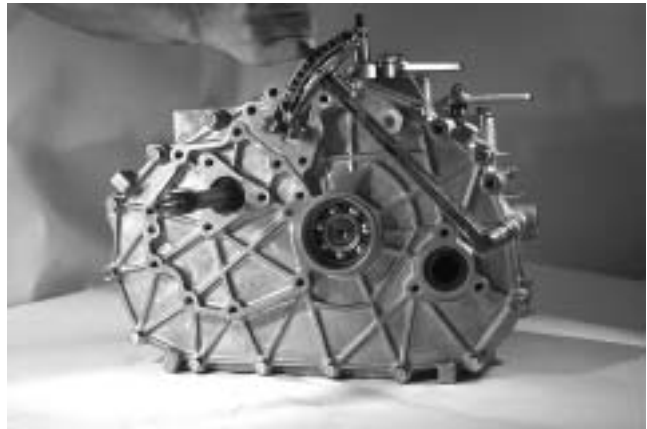


Figure 94

NOTE: The thickest shim of the shim set (Item 2) should be positioned against the snap ring (Fig. 95).

21. Insert tabbed shim (Item 4) against the bearing. Insert shim set (Item 2) against the tabbed shim. Use thickest shims in set possible, that will permit installation of the snap ring. (Fig. 95 and 96).

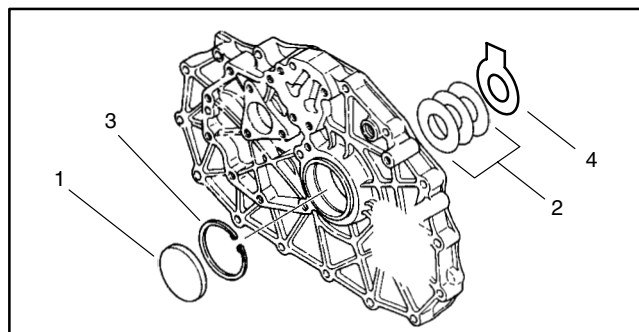


Figure 95

22. Install snap ring into the groove of the bearing housing (Fig. 96 and 97).

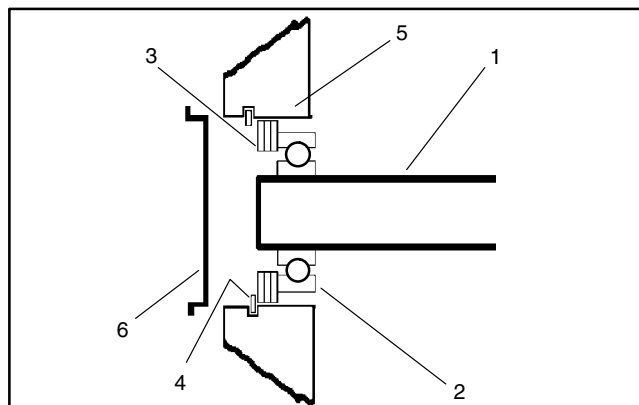


Figure 96

- | | |
|-----------------|-----------------|
| 1. Countershaft | 4. Snap ring |
| 2. Bearing | 5. Center plate |
| 3. Shims | 6. Sealing cap |



Figure 97

23. Measure countershaft end play. Rotate one of the axle shafts back and forth to take up all back lash. Rotating the shaft in one direction will pull the shaft and bearing away from the snap ring. Rotate axle shaft in this direction, then measure space between the snap ring and shim (set) with a feeler gauge. Make sure shim (set) is held against the bearing during the measurement. End play should be 0.000 to 0.0039 in. (0.00 to 0.10 mm) (Fig. 98).

IMPORTANT: If end play is too large, replace shim/shim set (item 2) in steps 21 and 22 with thicker shims to reduce endplay.



Figure 98

24. Insert sealing cap (Item 1) flush with face of housing. Make sure not to insert sealing cap too far. Pay attention to direction of sealing cap.

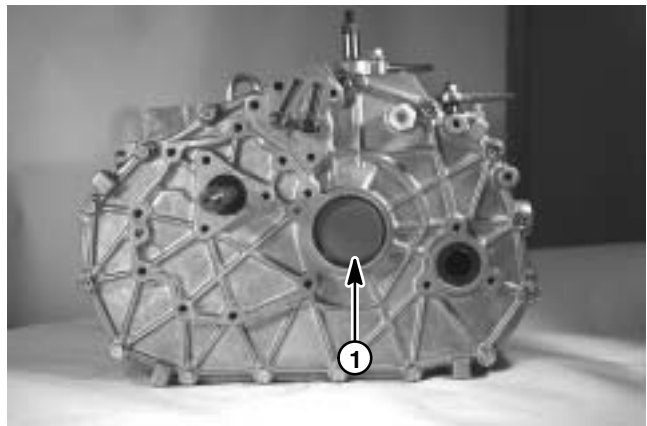


Figure 99

25. Install fork shaft case:

A. Insert spindle (Item 1) between fork shafts.

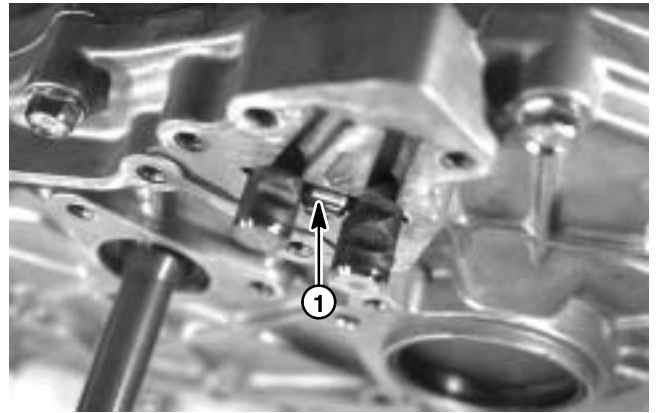


Figure 100

B. Insert 2 steel balls (Item 2) and 2 springs (Item 1) into the grooves.

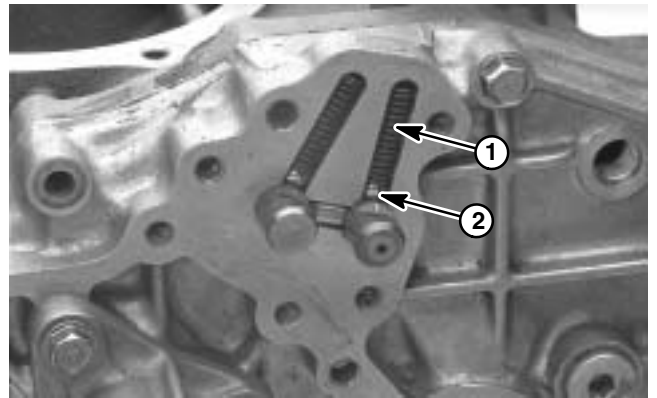


Figure 101

C. Apply silicone sealant to mating surface of fork shaft case.

D. Install fork shaft case (Item 2). Tighten cap screws (Item 1) to a torque from 18.5 to 22 ft-lb (24.5 to 29.5 N-m). Check operation of shifters and detent.

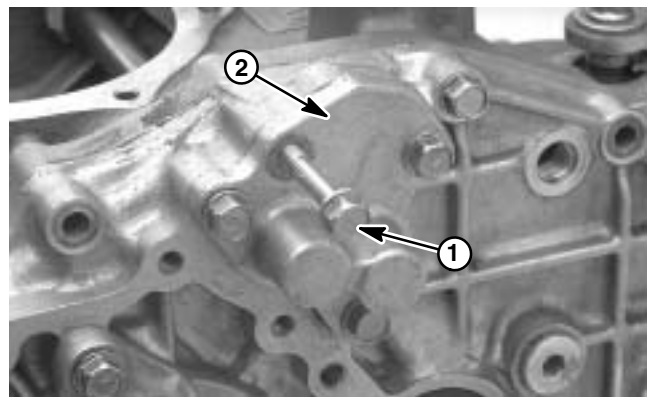


Figure 102

26. Insert a washer (Item 1) into housing of transaxle case. Apply moly disulfide grease to washer before installing.

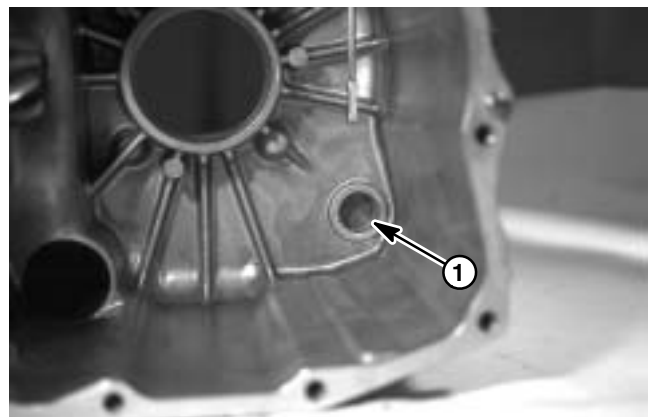


Figure 103

27. Install differential gear assembly (Item 1) together with fork shaft (Item 2) onto transaxle case.



Figure 104

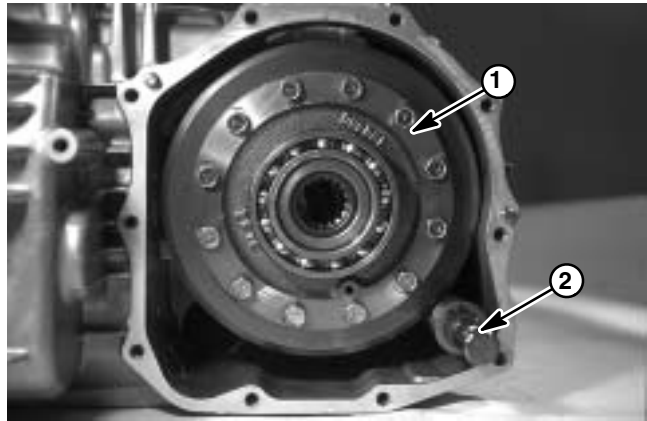


Figure 105

28. Install side cover:

- A. Insert 2 dowel pins onto transaxle case.
- B. Apply silicone sealant onto mating surface of side cover.
- C. Install side cover. Tighten cap screws to a torque from 18.5 to 22 ft-lb (24.5 to 29.5 N-m).



Figure 106

29. Install R.H. axle shaft assembly:

- A. Apply silicone sealant onto mating surface of seal cover.
- B. Install axle shaft assembly (Item 2) and tighten cap screws (Item 1) to a torque from 18.5 to 22 ft-lb (24.5 to 29.5 N-m).

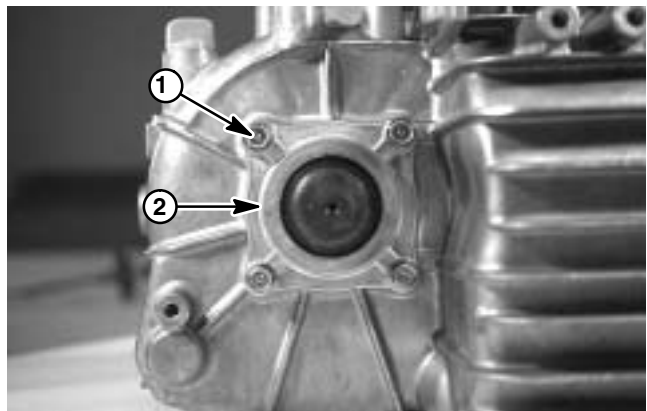


Figure 107

Workman 3000/4000 Series

30. Install L.H. axle shaft assembly:

A. Thoroughly clean mating surface of differential carrier and side cover (Item 1).

B. Insert selected shims (Item 2) into housing of side cover. **NOTE:** The thickest shim should be inserted against the bearing.

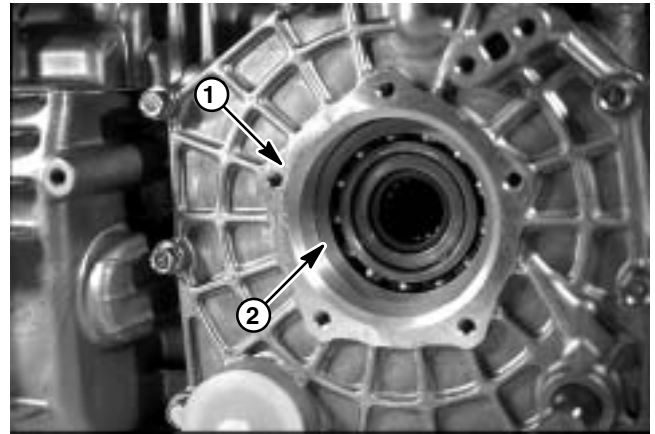


Figure 108

C. Install axle shaft assembly and tighten cap screws (Item 1) to a torque from 18.5 to 22 ft-lb (24.5 to 29.5 N-m).

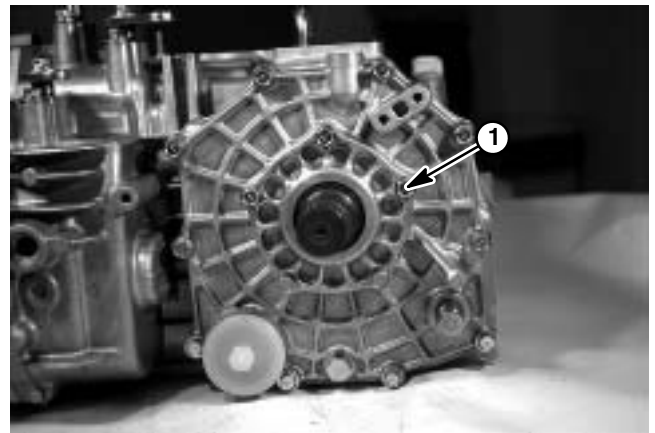


Figure 109

31. Measure backlash of ring gear through window on transaxle case. Using a dial indicator, check ring gear backlash in three equally spaced points. Backlash should be .0031 to .0071 in. (0.08 to 0.18 mm) and must not vary more than .0019 in. (0.05 mm) at the points checked. If backlash is not in this range, replace shim set in end of differential carrier:

A. If less than target range, decrease total thickness of shim set until correct backlash is achieved.

B. If exceeds the target range, increase total thickness of shim set until correct backlash is achieved.

NOTE: The thickest shim should be installed against the bearing.



Figure 110

32. Install differential lock arm (Item 1) onto fork shaft. Insert lock pin into fork shaft and arm. Pay attention to direction of slit in lock pin.

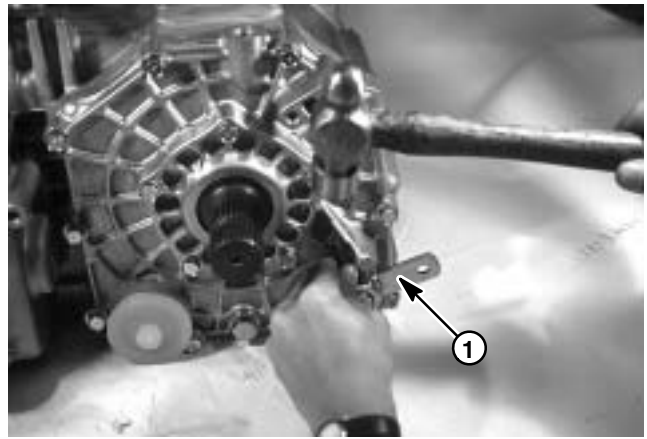


Figure 111

33. Apply silicone sealant to mating surface of upper cover (Item 2). Pay attention to direction of cover and install. Tighten cap screws (Item 1) to a torque from 18.5 to 22 ft-lb (24.5 to 29.5 N-m).

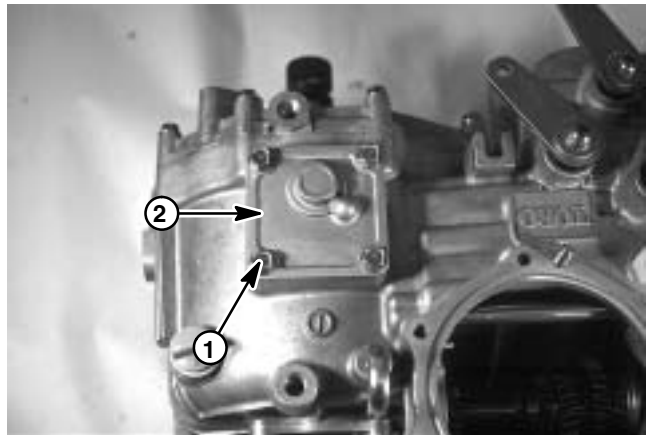


Figure 112

34. Apply multi-purpose grease to O-ring and insert O-ring into groove of transaxle case. If installing P.T.O., insert 2 dowel pins in transaxle case. Install P.T.O. or cover. Tighten nut with lockwasher (Item 2) and cap screws (Item 1) to a torque from 11 to 13 ft-lb (15 to 17 N-m).

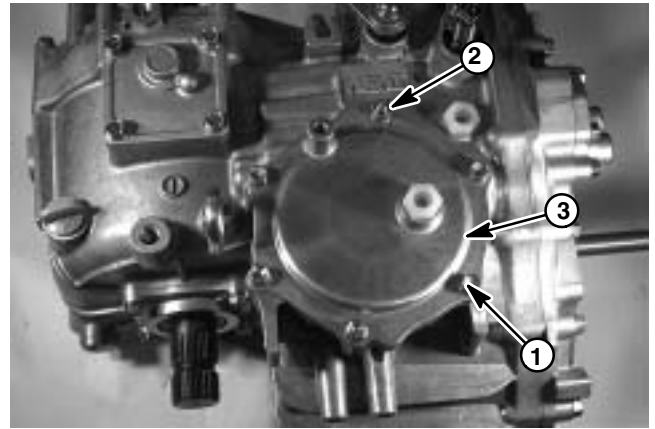


Figure 113

35. Install bell housing and secure with cap screws (Item 2). Tighten cap screws to a torque from 18.5 to 22 ft-lb (24.5 to 29.5 N-m).

36. Install extension spring (Item 1).

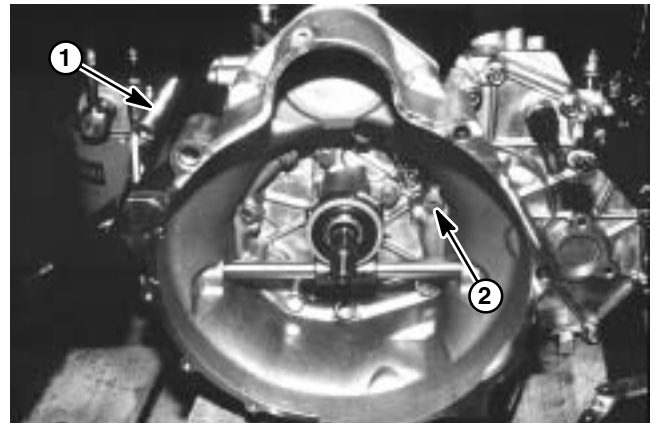


Figure 114

Power Take-Off (P.T.O.) Service

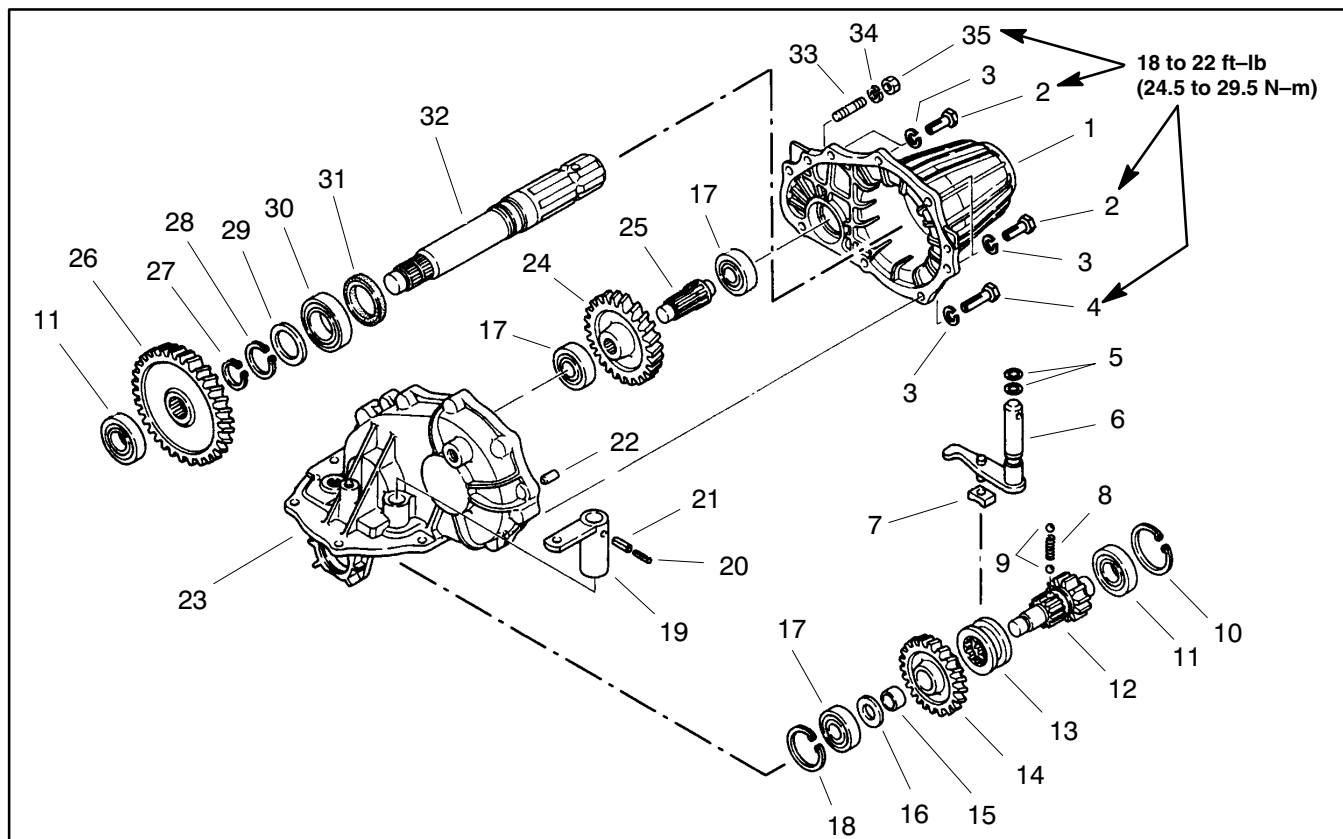


Figure 115

- | | | |
|-------------------------|----------------------------|------------------------|
| 1. PTO cover | 13. Shift collar | 25. Intermediate shaft |
| 2. Cap screw (4 used) | 14. Gear (29T) | 26. Gear (37T) |
| 3. Lock washer (7 used) | 15. Bushing | 27. Retaining ring |
| 4. Cap screw (3 used) | 16. Thrust washer | 28. Retaining ring |
| 5. O-ring | 17. Bearing | 29. Thrust washer |
| 6. Shift arm | 18. Retaining ring | 30. Bearing |
| 7. Shifter block | 19. Shift lever | 31. Oil seal |
| 8. Spring | 20. Spring pin | 32. Output shaft |
| 9. Ball | 21. Spring pin | 33. Stud |
| 10. Retaining ring | 22. Alignment pin (2 used) | 34. Lock washer |
| 11. Bearing | 23. PTO housing | 35. Hex nut |
| 12. Input shaft | 24. Gear (27T) | |

Disassembly (Fig. 115)

NOTE: Item numbers in figures are shown in order of disassembly; for example, remove Item 1 first, then Item 2, etc. Reassemble in reverse order; for example, install Item 1 last.

1. Put vehicle on a level surface. Stop the engine and remove key from ignition switch. Remove the bed or other attachment(s). Allow engine and radiator to cool.
2. Remove PTO from top of transaxle (see PTO Removal and Installation in this chapter).
3. Thoroughly clean outside surface of PTO case.
4. Loosen cap screws and nut. Note location and length of cap screws. Separate PTO cover from PTO housing.



Figure 116

5. Remove PTO output shaft assembly (Item 1) from PTO housing. Remove oil seal from PTO cover.

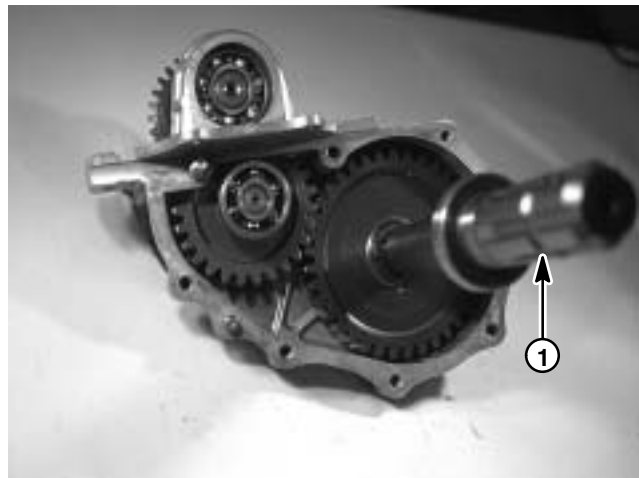


Figure 117

6. Remove intermediate shaft assembly (Item 1) from PTO housing. Remove intermediate gear (Item 2). Remove bearing (Item 3) from housing if necessary.

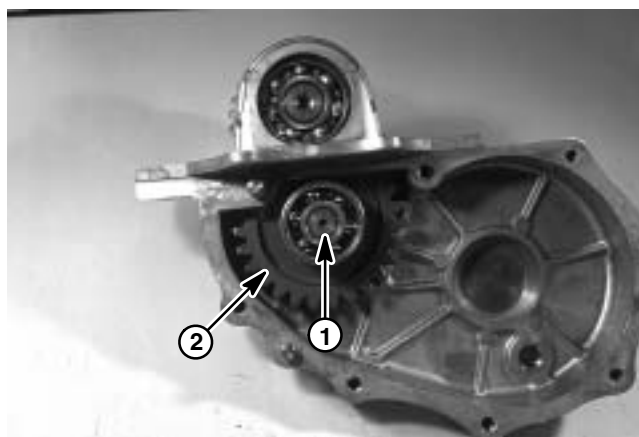


Figure 118

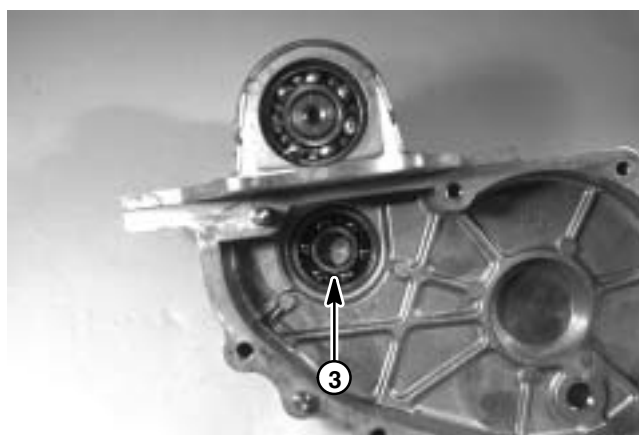


Figure 119

7. Remove PTO input shaft from PTO housing:

- A. Shift PTO to "ON" position.
- B. Remove 2 retaining rings (Items 1 and 2) from PTO housing.
- C. Slide input shaft assembly (Item 3) toward PTO shaft side.
- D. Remove bearing (Item 4).
- E. Slide input shaft toward other side.
- F. Remove bearing (Item 5).
- G. Remove thrust washer (Item 6) and gear (Item 7), sliding input shaft toward PTO shaft side.
- H. Release shift arm (Item 8) from shifter block (Item 9).
- I. Remove input shaft assembly.

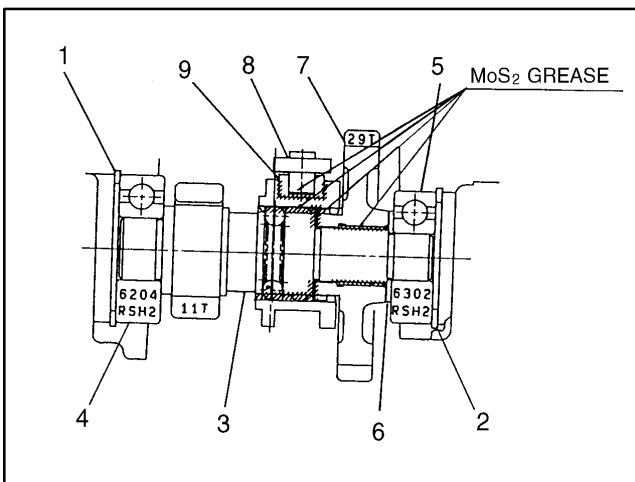


Figure 120

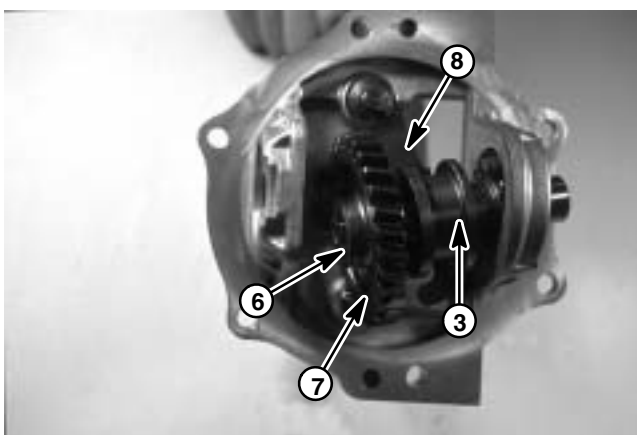


Figure 121

8. Disassemble PTO input shaft:

- A. Remove shift collar (Item 1).
- B. Remove 2 steel balls (Item 2) and spring (Item 3).

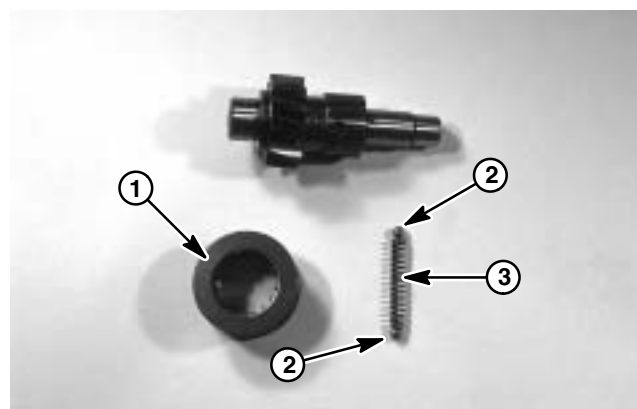


Figure 122

9. Disassemble PTO intermediate shaft:

- A. Use a bearing puller to remove bearing (Item 1) if necessary.

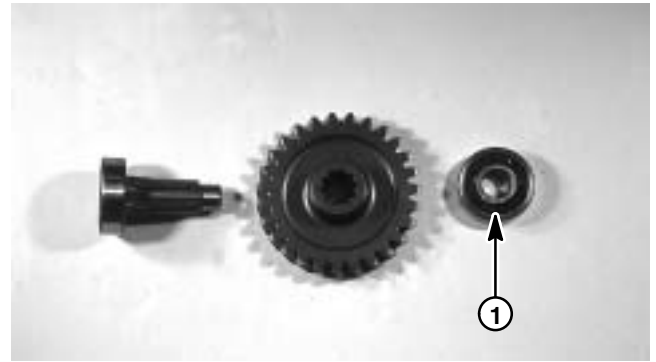


Figure 123

10. Disassemble PTO output shaft:

- A. Use a bearing puller to remove bearing (Item 1).
B. Remove gear (Item 2) and retaining ring (Item 3).
C. Remove retaining ring (Item 4) and thrust washer (Item 5).
D. Use a bearing puller to remove bearing (Item 6) if necessary.

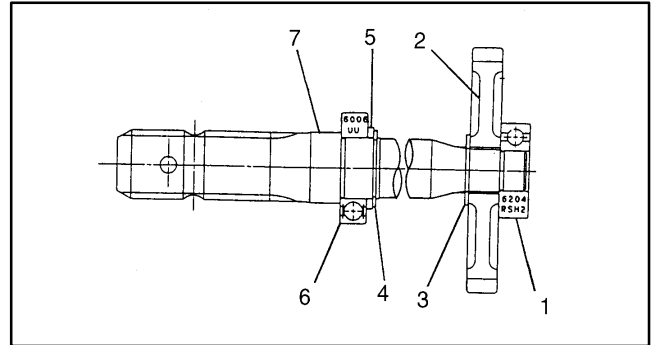


Figure 124

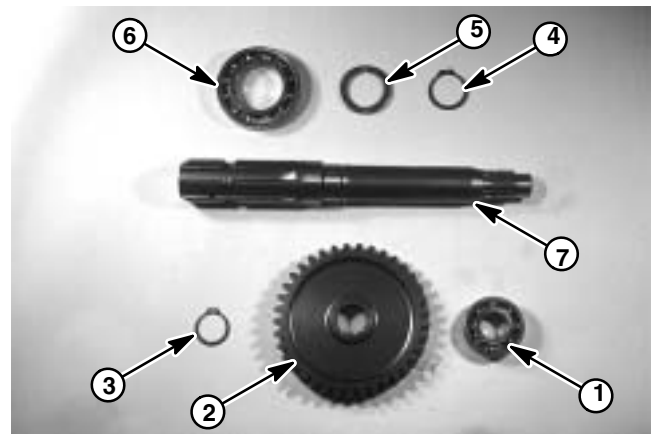


Figure 125

11. Disassemble shift arm:

- A. Remove two (2) lock pins from shift arm.
B. Remove two (2) O-rings (Item 1).

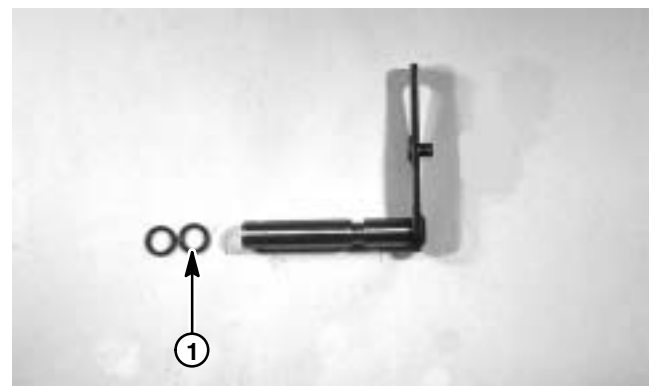


Figure 126

Inspection

1. Thoroughly clean and dry all parts.
2. Use emery cloth to remove nicks and burrs from all parts.
3. Measure clearance between groove on shift collar and shifter block. Replace shifter block if clearance exceeds .039 in. (1.0 mm).

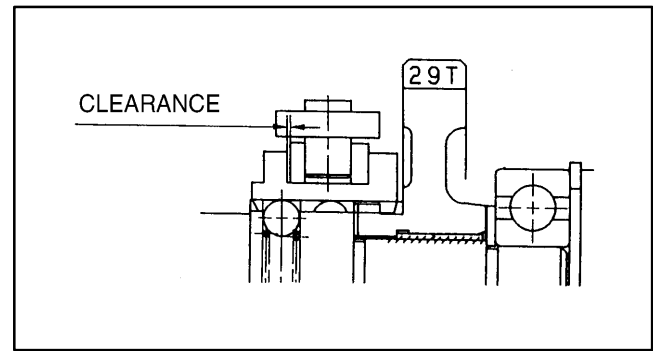


Figure 127

4. Measure I.D. of input shaft bushing (Item 1). Replace bushing if I.D. exceeds .673 in. (17.10 mm).

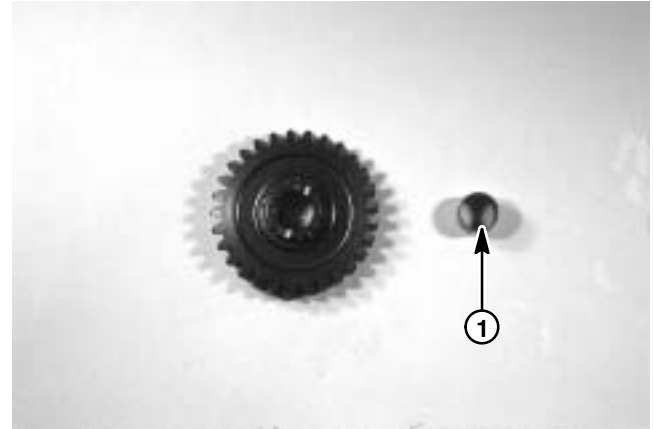


Figure 128

5. Measure O.D. of bushing area on input shaft. Replace shaft if O.D. is less than .667 in. (16.95 mm). Inspect surface of bushing area for scoring or damage.

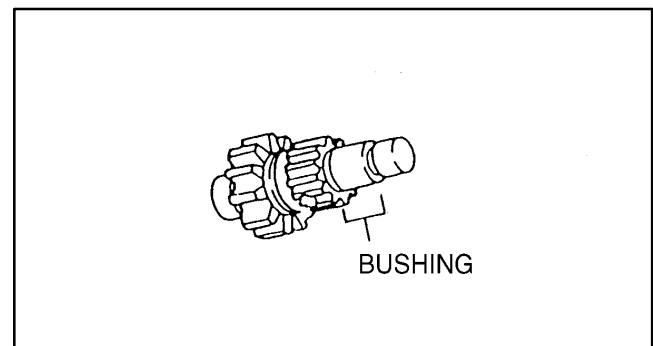


Figure 129

6. Inspect surface of oil seal area on output shaft for wear or damage.

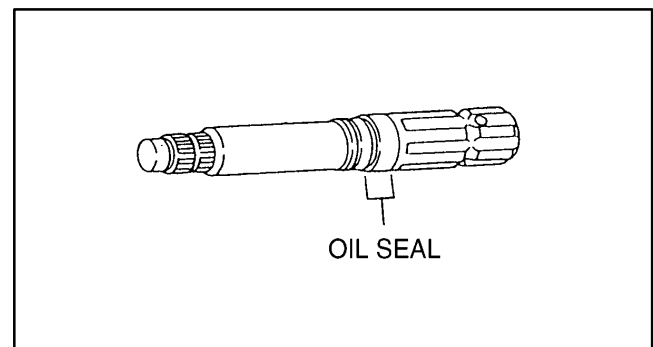


Figure 130

Assembly (Fig. 115)

NOTE: Item numbers in figures are shown in reverse order of assembly; for example, when reassembling, install Item 1 last.

1. Clean gasket material from mating surfaces of housing and cover.

IMPORTANT: Be careful not to damage mating surfaces when removing gasket material.

2. Make sure all parts are free of dirt and dust.

3. Assemble shift arm:

A. Install two (2) new O-rings (Item 1) onto shift arm. Apply moly disulfide grease to O-rings before installing.

B. Apply moly disulfide grease to arm pin and shaft.

C. Install shift arm into PTO housing.

D. Install shift lever onto shift arm.

E. Drive lock pins into shift lever and shift arm. Pay attention to direction of slit in lock pins.

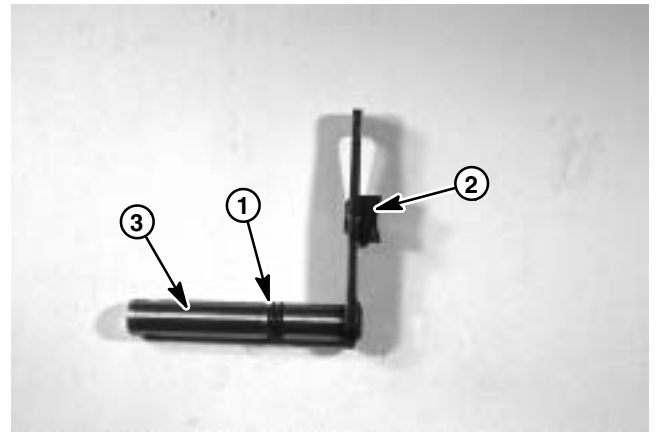


Figure 131

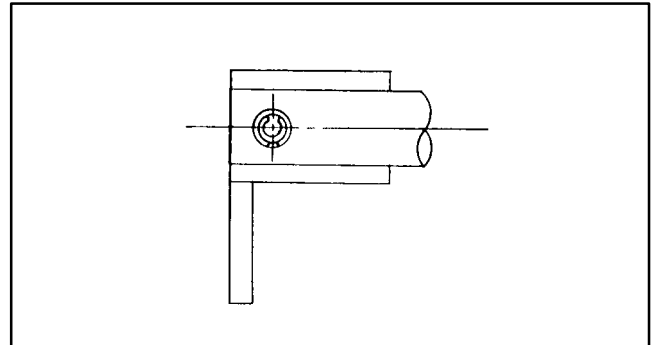


Figure 132



Figure 133

4. Assemble PTO output shaft:

- A. If bearing (Item 6) was removed, use a press to install bearing onto output shaft.
- B. Install washer (Item 5) and retaining ring (Item 4).
- C. Install retaining ring (Item 3) and gear (Item 2).
- D. Use a press to install bearing (Item 1).

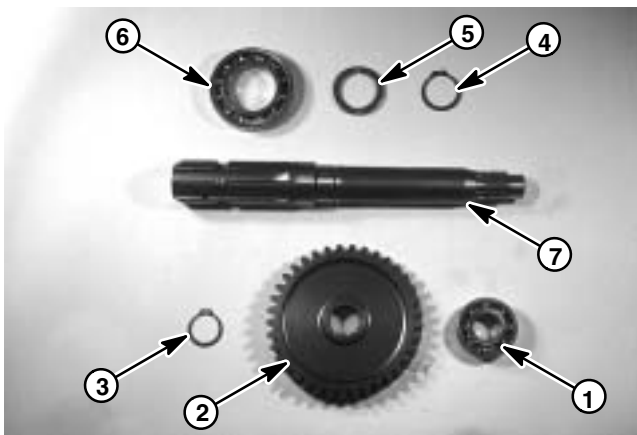


Figure 134

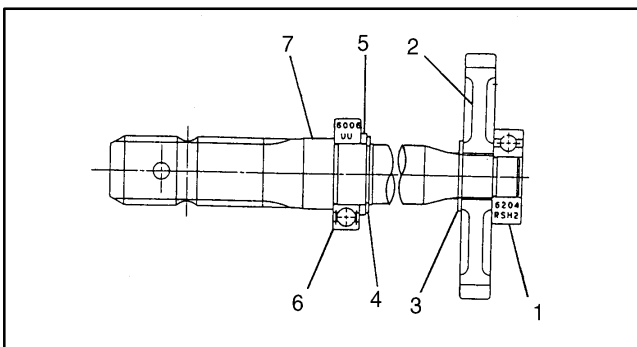


Figure 135

5. Use a press to install bearing (Item 1) onto intermediate shaft.



Figure 136

6. Assemble PTO input shaft:

- A. Insert spring (Item 3) and two (2) steel balls (Item 2) into hole.
- B. Insert shift collar (Item 1) onto input shaft.
- C. Move shift collar to "ON" position.

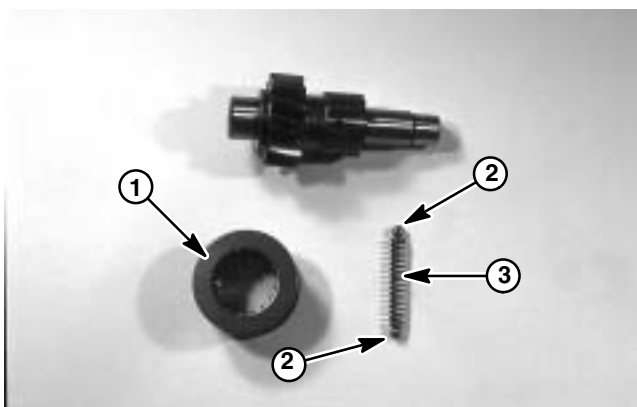


Figure 137

7. Install PTO input shaft sub-assembly:

A. Insert shifter block (Item 9) onto pin of shift arm. Apply moly disulfide grease onto both sides of block before installing.

B. Put shift collar of PTO input shaft sub-assembly (Item 3) on the shifter block.

C. Install gear (Item 7) with bushing and thrust washer (Item 6) onto input shaft after sliding the assembly toward PTO shaft side. Apply moly disulfide grease to bushing of gear and thrust washer before installing.

D. Slide two (2) bearings (Items 5 and 4) onto input shaft.

E. Install two (2) retaining rings (Items 2 and 1).

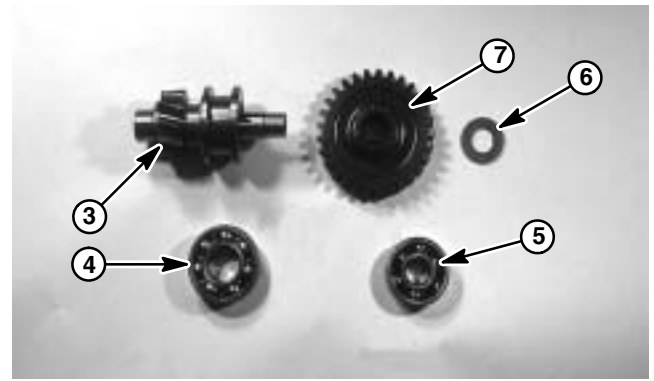


Figure 138

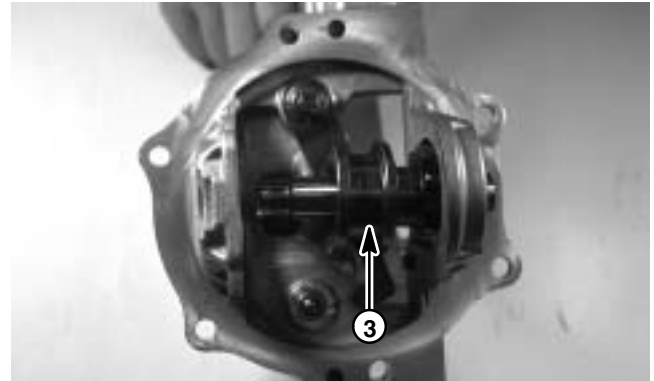


Figure 139

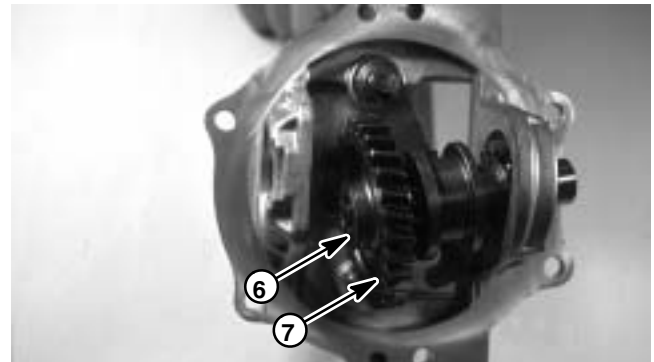


Figure 140

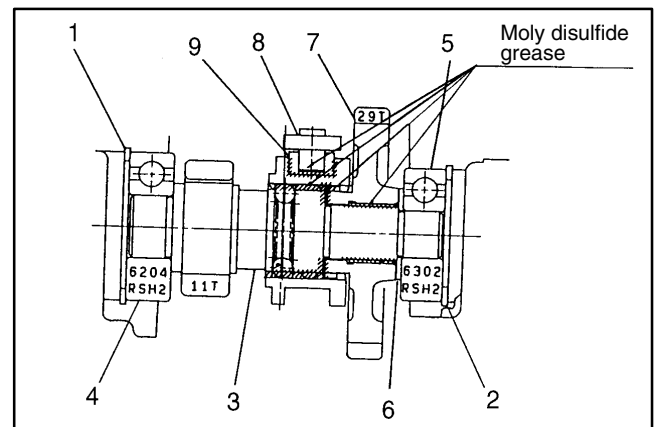


Figure 141

8. Install PTO intermediate shaft sub-assembly:

A. If removed during disassembly, insert bearing (Item 3) into PTO housing.

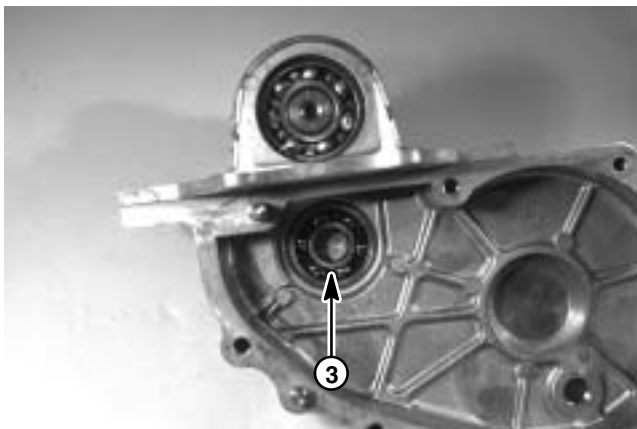


Figure 142

B. Put gear (Item 2) on mating gear.

C. Move gear until bores of gear and bearing line up.

D. Insert intermediate shaft sub-assembly (Item 1).
Apply grease to intermediate shaft to aid assembly.

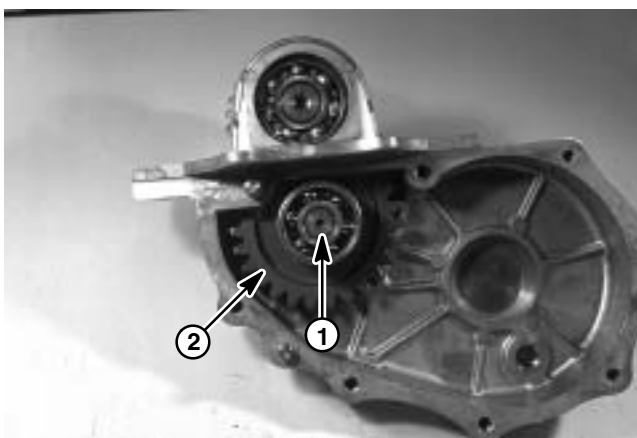


Figure 143

9. Insert PTO shaft assembly (Item 1) into bearing housing of PTO housing.

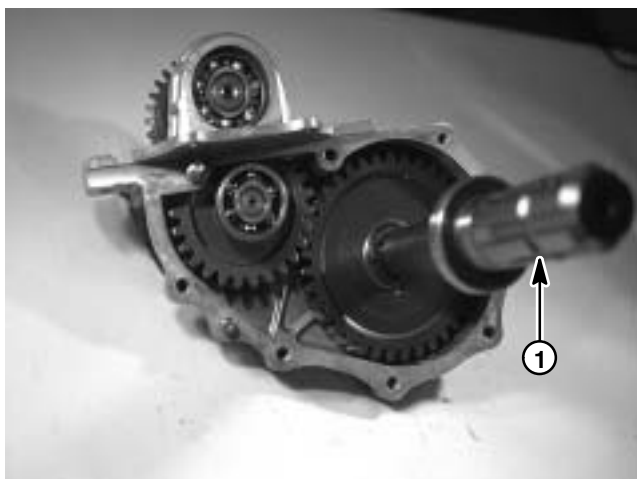


Figure 144

10. Install PTO cover:

- A. Insert new oil seal into PTO cover. Apply multi-purpose grease to lip of oil seal.
- B. Insert two (2) alignment pins into PTO housing.
- C. Apply silicone sealant onto mating surface of PTO cover.
- D. Install PTO cover. Tighten cap screws and nut with lockwasher to a torque from 18 to 22 ft-lb (24.5 to 29.5 N-m).

11. Install PTO to transaxle (see PTO Removal and Installation in this chapter).



Figure 145

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Specifications

Item	Specification
Front wheel toe-in	0 to 0.125 in. (0 to 3 mm)
Front tire	20" x 10" – 10, 4 ply
Maximum front tire pressure	20 PSI
Rear tire	24" x 12" – 12, 6 ply
Maximum rear tire pressure	18 PSI
Wheel nut torque	45 to 65 ft-lb (61 to 88 N-m)
Brake fluid	DOT 3

Tire Pressure

1. Tire pressure needed is determined by the payload carried.
2. The lower the air pressure, the less the compaction, and tire marks are minimized. Lower pressure should not be used for heavy payloads at high speeds. Tire damage may result.
3. High pressure should be used for heavier payloads at higher speeds. Do not exceed maximum tire pressure.
4. See Operator's Manual for additional tire pressure information.

Special Tools

Compression Spring Tool

Use to remove and install the two (2) front suspension compression springs.

Qty.	Item
2	1/2" x 20" threaded steel rods
4	1/2" nuts
4	1/2" flat washers

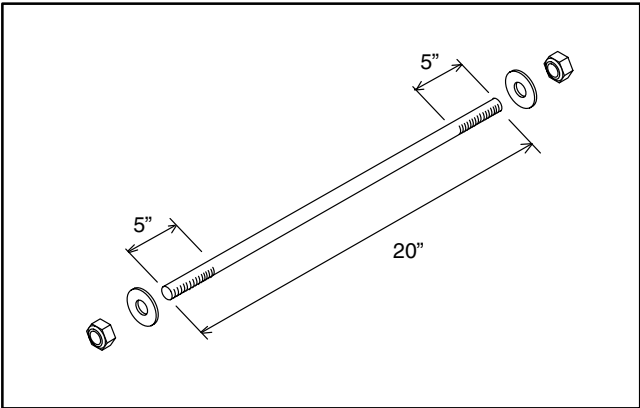


Figure 1

Troubleshooting

Suspension and Steering

Problem	Possible Causes
Front end noise.	Loose or worn front wheel bearings. Worn front shock absorbers. Worn stabilizer link bushings. Loose steering components (e.g. tie rods, steering cylinder). Worn control arm bushings. Tire pressure low (4WD vehicles). Worn tires (4WD vehicles).
Rear end noise.	Worn or brinelled rear wheel bearings. Worn rear shock absorbers. Worn leaf spring bushings. Clutch, drive shaft or transaxle problem (see Chapter 6 – Drive Train).
Excessive steering play.	Loose or worn front wheel bearings. Loose or worn steering linkage. Worn tie rod ends.
Front wheel shimmy.	Loose or worn front wheel bearings. Tires out of round or uneven tire wear. Worn tie rod ends. Incorrect front wheel alignment (toe-in). Worn shock absorbers.
Instability (wander).	Low or uneven tire pressure. Worn or loose wheel bearings. Worn pitman arm bushings. Broken or loose rear leaf spring. Worn shock absorber(s). Incorrect front wheel alignment (toe-in). Worn or loose ball joints.

Suspension and Steering (Continued)

Problem	Possible Causes
Hard steering.	<ul style="list-style-type: none">Loose, worn or glazed hydraulic pump drive belt.Binding or damaged steering linkage.Low or uneven tire pressure.Low hydraulic pressure (see Chapter 9 – Hydraulic System).Damaged or binding steering cylinder.Worn or damaged steering control valve.Incorrect front wheel alignment.
Vehicle pulls to one side when not braking.	<ul style="list-style-type: none">Low or uneven tire pressure.Broken or weak rear leaf spring.Incorrect front wheel alignment.Damaged or bent suspension or steering component.Worn or damaged brake components.

Brakes

Problem	Possible Causes
Brake pedal goes to floor.	Incorrectly adjusted brakes. Low brake fluid level. Air in brake system. Leaking wheel cylinder(s). Loose or broken brake lines. Leaking or worn brake master cylinder. Excessively worn brake shoes or drums.
Spongy brake pedal.	Air in brake system. Excessively worn or cracked brake drums. Broken or worn brake pedal pivot bushing.
Brakes pulling.	Incorrect tire pressure. Contaminated brake linings. Front end out of alignment. Incorrect brake adjustment. Distorted brake shoes. Restricted brake lines or hoses. Broken rear spring. Unmatched tires on same axle.
Squealing brakes.	Glazed brake lining. Saturated brake lining. Weak or broken shoe return spring. Weak or broken shoe retaining spring. Distorted brake shoes. Bent support plate. Dust in brake drums and brakes. Scored brake drums. Out of round drums.

Brakes (Continued)

Problem	Possible Causes
Dragging brakes.	Improper brake or parking brake adjustment. Parking brake engaged. Weak or broken brake shoe return spring. Binding brake pedal. Sticking brake master cylinder. Saturated brake linings. Bent or out of round brake drums.
Hard brake pedal.	Incorrect brake lining material. Restricted brake lines or hoses. Brake pedal linkage binding.
Wheel locks.	Contaminated brake linings. Loose or damaged brake linings. Wheel cylinder sticking. Incorrect wheel bearing adjustment.
Brakes fade.	Overheated brake drums. Saturated brake linings.
Surge at slow speeds. Chatter at fast speeds.	Bent or out of round brake drums.
Shoe lock.	Machining grooves in contact face of brake drums. Weak hold down springs.
Brakes do not self adjust.	Adjuster bolt seized in thread. Adjuster lever does not engage star wheel.

Service and Repairs

Wheel Installation

1. Mount wheel and evenly tighten wheel nuts to a torque from 45 to 65 ft-lb (61 to 88 N-m).



WARNING

Failure to maintain proper wheel nut torque could result in failure or loss of wheel and may result in personal injury. Torque front and rear wheel nuts from 45 to 65 ft-lb (61 to 88 N-m) at intervals recommended in Operator's Manual.

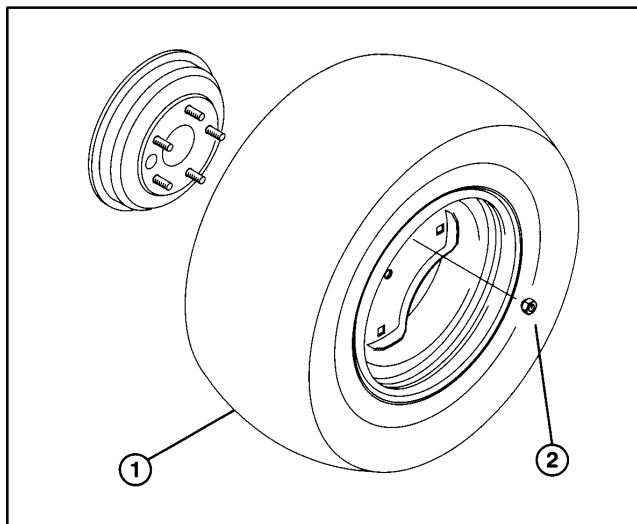


Figure 2

1. Wheel assembly

2. Wheel nut (5 used)

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Front Wheel Assembly (2 Wheel Drive)

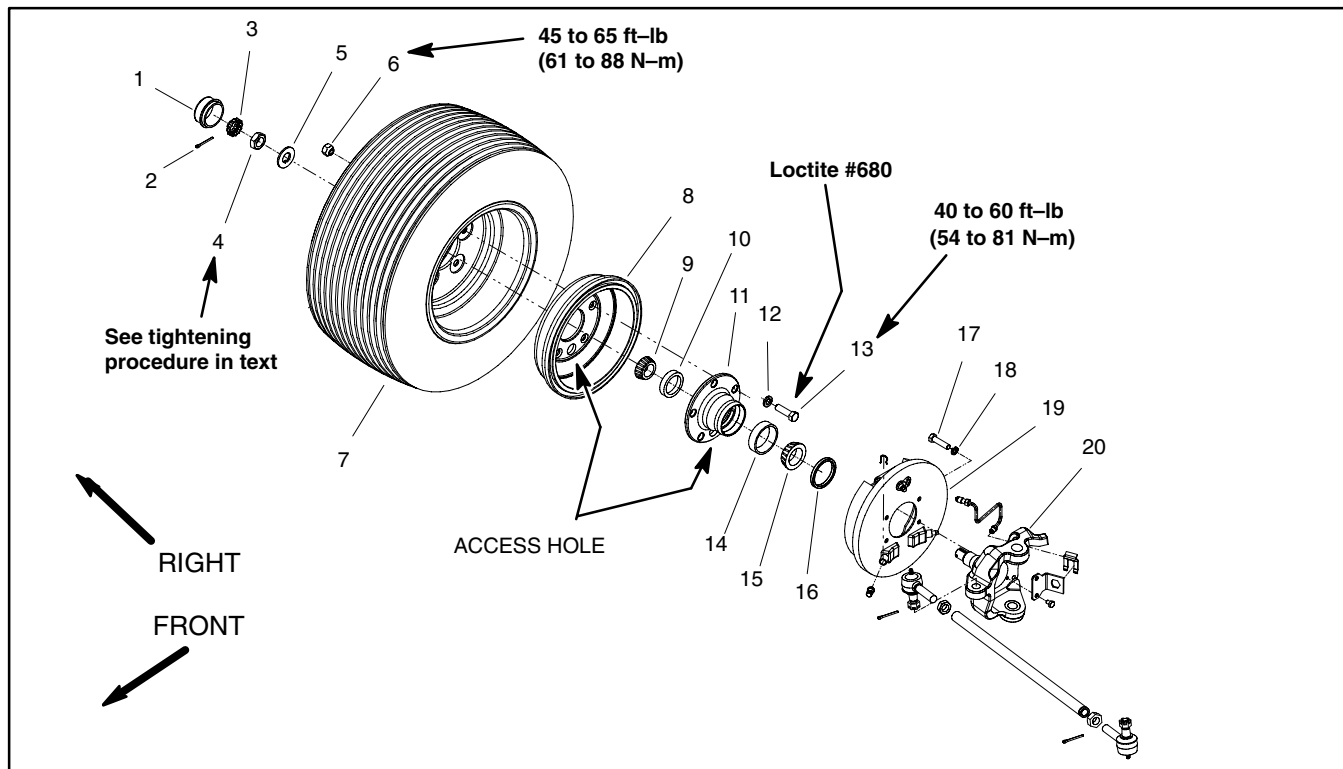


Figure 3

- | | | |
|---------------------------------|------------------------------------|------------------------------------|
| 1. Dust cap | 8. Brake drum | 15. Inner bearing cone |
| 2. Cotter pin | 9. Outer bearing cone | 16. Bearing seal |
| 3. Nut retainer | 10. Outer bearing cup | 17. Cap screw (4 used per brake) |
| 4. Jam nut | 11. Front hub | 18. Lock washer (4 used per brake) |
| 5. Tab washer | 12. Lock washer (5 used per wheel) | 19. Brake assembly (RH shown) |
| 6. Wheel nut (5 used per wheel) | 13. Hex bolt (5 used per wheel) | 20. Spindle (RH shown) |
| 7. Wheel assembly | 14. Inner bearing cup | |

NOTE: For Workman 4000 Series front wheel service procedures, see Front Wheel and Axle Housing Assembly in the Service and Repairs section of Chapter 10 – Front Wheel Drive (4WD).

Disassembly (Fig. 3)

1. Partially loosen wheel nuts, then jack up and support front of vehicle (see Jacking Instructions in Operator's Manual). Remove wheel nuts and then remove wheel assembly.

NOTE: It may be necessary to back off brake adjuster to remove brake drum. To back off adjuster, rotate brake drum until access hole lines up with star wheel on adjuster assembly. Use a hooked piece of wire to pull pawl away from star wheel, then turn star wheel.

2. Remove brake drum from front hub.

3. Remove dust cap. Straighten and remove cotter pin from spindle shaft. Remove nut retainer, jam nut, tab washer and outer bearing cone. Pull wheel hub from spindle.

4. Pull seal out of wheel hub and discard seal. Remove inner bearing cone from wheel hub. Check bearing cups for wear, pitting or other damage. Replace worn or damaged parts.

Assembly (Fig. 3)

1. If hex bolts and lock washers were removed from the from hub:

A. Thoroughly clean threads of hex bolt and hub. Apply Loctite #680 (or equivalent) to threads of hex bolt closest to bolt head.

B. Install hex bolt with lock washer into stub axle. Torque bolt from 40 to 60 ft-lb (54 to 81 N-m).

2. If bearing cups were removed from hub, press new cups into hub until they seat against inside shoulder of hub.

3. Pack inner bearing cone with grease. Install inner bearing cone into bearing cup in hub. Apply grease to new seal and press into wheel hub.

4. Carefully slide wheel hub with inner bearing cone and seal onto spindle. Fill cavity of wheel hub 50% full with grease.

5. Pack outer bearing cone with grease and insert it into wheel hub over spindle. Install tab washer over bearing and secure hub to spindle with jam nut. **DO NOT** tighten jam nut.

6. While rotating wheel hub, tighten jam nut to a torque from 75 to 180 in-lb (8.5 to 20.3 N-m). Back off jam nut until there is clearance between jam nut and tab washer. While rotating wheel hub, retighten jam nut to a torque from 10 to 15 in-lb (12 to 17 kg-cm). Position nut retainer to allow installation of cotter pin. Install cotter pin and bend cotter pin completely around nut retainer. Install dust cap.

7. Install brake drum making sure that access hole in brake drum aligns with hole in front hub.

8. Adjust brake shoes:

A. Align access hole in brake drum with adjuster bolt on adjuster assembly.

B. Rotate adjusting bolt to increase adjuster length until brake shoes contact brake drum.

C. Back off adjuster until drum rotates freely.

9. Install wheel. Secure with wheel nuts. Tighten lug nuts in a crossing pattern to a torque from 45 to 65 ft-lb (61 to 88 N-m).



CAUTION

After reassembly, check the brakes in a wide open, level area that is free of other persons and obstructions.

10. Check brake operation.

Rear Wheel Assembly

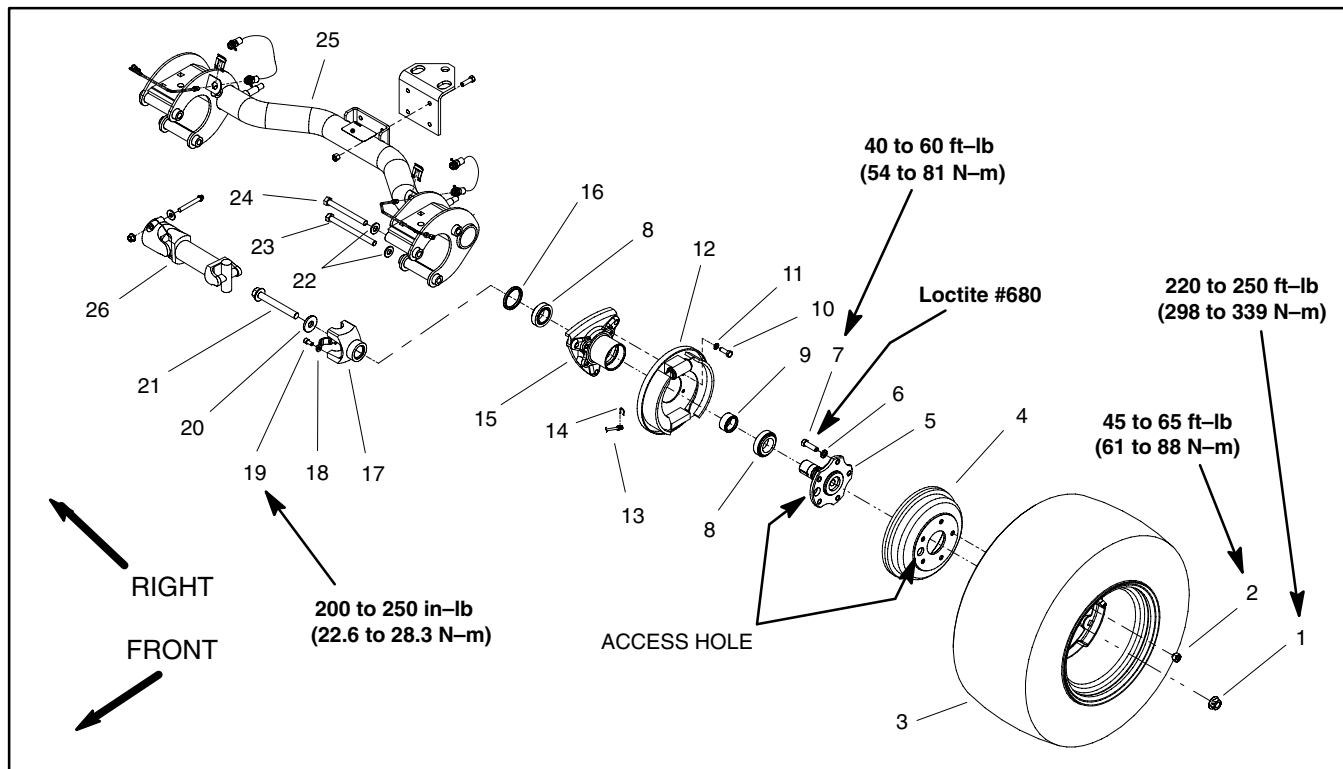


Figure 4

- | | | |
|-----------------------------------|------------------------------------|-----------------------------|
| 1. Flange nut | 10. Cap screw (4 used per brake) | 19. Bolt (2 used per strap) |
| 2. Wheel nut (5 used per wheel) | 11. Lock washer (4 used per brake) | 20. Hardened washer |
| 3. Wheel assembly | 12. Brake assembly | 21. Flange head screw |
| 4. Brake drum | 13. Parking brake cable | 22. Thrust washer |
| 5. Stub axle | 14. Cable clip | 23. Cap screw |
| 6. Lock washer (5 used per wheel) | 15. Axle housing | 24. Cap screw |
| 7. Hex bolt (5 used per wheel) | 16. Seal | 25. Rear axle |
| 8. Bearing | 17. End yoke | 26. Drive shaft |
| 9. Bearing spacer | 18. Yoke strap (2 used per yoke) | |

For rear wheel assembly service procedures, see Stub Axle and Drive Shaft Service in the Service and Repairs section of Chapter 6 – Drive Train.

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Brake Service

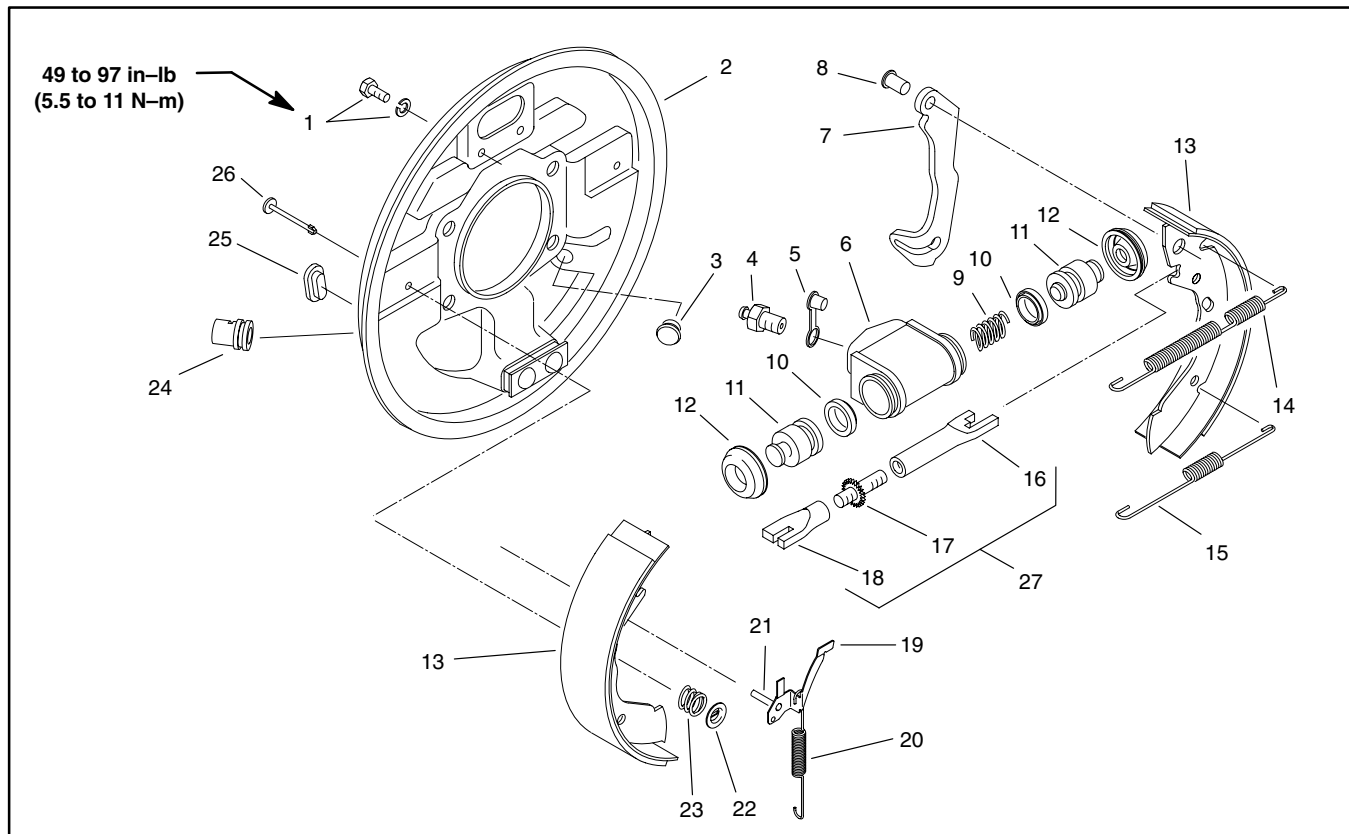


Figure 5

- | | | |
|---------------------------------------|-----------------------|-------------------------------|
| 1. Cap screw and lock washer (2 used) | 10. L-type seal | 19. Pawl |
| 2. Backing plate | 11. Piston | 20. Adjuster spring |
| 3. Plug | 12. Dust cover | 21. Pawl pin |
| 4. Bleed screw | 13. Brake shoe | 22. Hold down washer (2 used) |
| 5. Bleed screw cap | 14. Upper shoe spring | 23. Hold down spring (2 used) |
| 6. Brake cylinder body | 15. Lower shoe spring | 24. Pipe guide |
| 7. Parking brake lever | 16. Female push rod | 25. Inspection plug |
| 8. Pin | 17. Bolt adjuster | 26. Hold down pin (2 used) |
| 9. Spring | 18. Adjuster sleeve | 27. Adjuster assembly |

Disassembly (Fig. 5 and 6)

1. Partially loosen wheel nuts then jack up and support vehicle (see Jacking Instructions in Operator's Manual). Remove wheel nuts and then remove wheel.

2. If servicing rear brakes, loosen set screw on parking brake control lever knob. Turn knob on parking brake lever counterclockwise all the way to loosen parking brake cable adjustment.

NOTE: It may be necessary to back off adjuster to remove brake drum. To back off adjuster, rotate brake drum until access hole lines up with bolt adjuster on adjuster assembly. Use a hooked piece of wire to pull pawl away from bolt adjuster, then turn bolt adjuster.

3. Remove brake drum.

4. If servicing front brakes, remove wheel hub from vehicle (see Front Wheel Assembly (2 Wheel Drive) in this section for series 3000 Workman vehicle or see Front Wheel and Axle Housing Assembly in the Service and Repairs section of Chapter 10 – Front Wheel Drive (4WD) for series 4000 Workman vehicle).

5. If servicing rear brakes, remove stub axle from vehicle (see Stub Axle and Drive Shaft Service in the Service and Repairs section of Chapter 6 – Drive Train).

6. Remove upper shoe spring (14), adjuster spring (20) and then lower shoe spring (15).

NOTE: The adjuster assembly (27) consists of the female push rod (16), bolt adjuster (17) and adjuster sleeve (18).

7. Remove hold down washers (22) and hold down springs (23) from the hold down pins (26). Remove brake shoes (13), pawl (19) and adjuster assembly (27).

8. If servicing rear brakes, disengage parking brake cable from parking brake lever.

9. See Brake Cylinder Service in this section for information on brake cylinder disassembly, inspection and assembly procedures.

10. If needed, remove brake backing plate from vehicle by removing four cap screws and lock washers.

Inspection

1. Clean and inspect brake drum any time they are removed for brake service.

A. Check drum diameter at a minimum of three locations. Diameter should not exceed the over size limit cast into the outside of the drum. Replace drum if limit is exceeded.

B. Replace drums if they are cracked or heat spotted.

C. Scoring, grooves, taper, out of round and glazing can be machined out as long as the oversize limit is not exceeded. Minor scoring or glazing can be removed with sand paper.

IMPORTANT: If one drum is machined, the drum on the opposite side should be machined to the same diameter to maintain equal braking forces.

D. Wipe braking surface of drum after machining with a cloth soaked in denatured alcohol.

2. Inspect brake shoe and lining set (13).

IMPORTANT: Shoe and lining sets should be replaced for both wheels on the axle. Equal braking forces must be maintained.

A. Replace if linings are excessively worn or damaged. Oil, grease or brake fluid contamination is not acceptable.

B. Replace if shoe webbing show signs of overheating as indicated by a slight blue color.

3. Inspect hold down washer (22), hold down spring (23) and hold down pin (26). Replace parts if rusted, corroded or bent. Replace washers and springs if they are unable to lock onto the pin.

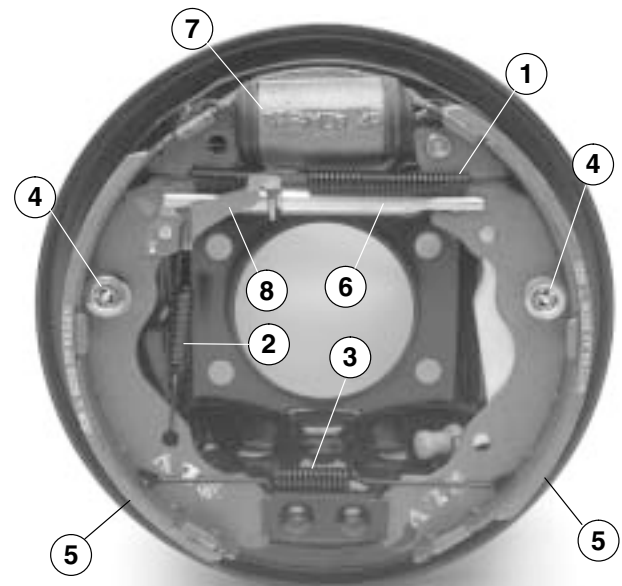


Figure 6

- | | |
|----------------------|------------------------|
| 1. Upper shoe spring | 5. Brake shoe |
| 2. Adjuster spring | 6. Adjuster assembly |
| 3. Lower shoe spring | 7. Brake cylinder assy |
| 4. Hold down washer | 8. Pawl |

4. Inspect upper shoe spring (14), lower shoe spring (15) and adjuster spring (20).

A. Replace if springs show signs of overheating as indicated by a slight blue color. Over heated springs lose their tension and could cause brake linings to wear out prematurely.

B. Replace sagging, bent or externally damaged springs.

5. Inspect backing plate (2).

A. Replace if shoe contact surfaces have grooves that may restrict shoe movement and can not be removed by sanding lightly with emery cloth.

B. Replace if cracked, warped or excessively rusted.

6. Inspect female push rod (16), bolt adjuster (17) and adjuster sleeve (18) for rust, corrosion, bending and fatigue. Replace parts as necessary.

Assembly (Fig. 5 and 6)

1. If backing plate was removed from vehicle, secure backing plate to vehicle with four cap screws and lock washers.

2. If brake cylinder was removed from backing plate, install cylinder assembly (see Brake Cylinder Service in this section).

3. Clean backing plate (2). Lubricate shoe contact areas with a thin coat of grease.

4. Apply a light coat of grease to the threaded areas of the adjuster assembly (27).

5. Position brake shoe set (13) onto the backing plate (2). Secure shoes with hold down pins (26), hold down springs (23) and hold down washers (22).

6. On rear brakes only: attach parking brake cable to parking brake lever. After installing cable to each rear brake, check to make sure bottoms of brake shoes are seated in grooves at bottom of backing plate.

7. Install lower shoe spring (15) to both brake shoes (13).

8. Install adjuster assembly (27) in the slots on the brake shoes (13). Install pawl (19) into brake shoe and onto top of bolt adjuster (17).

9. Install adjuster spring (20) to pawl (19) and brake shoe (13).

10. Install upper shoe spring (14) to both brake shoes (13).

11. If servicing front brakes, install wheel hub to vehicle (see Front Wheel Assembly (2 Wheel Drive) in this section for series 3000 Workman vehicle or see Front Wheel and Axle Housing Assembly in the Service and Repairs section of Chapter 10 – Front Wheel Drive (4WD) for series 4000 Workman vehicle).

12. If servicing rear brakes, install stub axle to vehicle (see Stub Axle and Drive Shaft Service in the Service and Repairs section of Chapter 6 – Drive Train).

13. Install brake drum. **NOTE:** On rear wheels, make sure access hole in brake drum aligns with hole in stub axle flange. On front wheels, access hole in brake drum should align with hole in front hub.

14. Adjust brake shoes:

A. Align access hole in brake drum with bolt adjuster.

B. Rotate bolt adjuster to increase adjuster length until brake shoes contact brake drum.

C. Back off adjuster until drum rotates freely.

15. Install wheel and secure with wheel nuts. Tighten wheel nuts in a crossing pattern to a torque from 45 to 65 ft-lb (61 to 88 N-m).



CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

16. After servicing brakes, start the engine and depress brake pedal several times while vehicle is moving in reverse.

17. Adjust parking brake (see Operator's Manual).

Burnish Brake Shoes

To ensure maximum brake performance after brake shoes are replaced, burnish new brake shoes.

IMPORTANT: While burnishing brakes, do not allow the brakes to lock up. Allow brakes to cool between applications.

1. Drive vehicle while making 6 to 7 normal stops at about 200 ft (60 m) intervals while traveling at 10 to 15 mph (16 to 24 KPH).

2. Make several normal stops with the vehicle going in the reverse direction. This will self adjust the clearance between the brake shoe and drum.

Wheel Brake Cylinder Service

Disassembly

1. Disassemble brakes as described in Brake Service.
2. If brake line is still attached to brake cylinder, disconnect brake line from cylinder. Put a cap on brake line to prevent contamination of system and brake fluid leakage.
3. Remove two (2) cap screws and lock washers that secure brake cylinder to brake backing plate. Remove brake cylinder assembly.
4. Remove dust covers, pistons, L-type seals and spring from brake cylinder body (Fig. 7). Discard dust covers and seals.

Inspection



CAUTION

Use eye protection such as goggles when using compressed air.

1. Clean all metal parts with isopropyl alcohol, then clean out and dry grooves and passageways with compressed air. Make sure brake cylinder bore and component pieces are thoroughly clean.
2. Check cylinder bore and pistons and spring for damage or excessive wear. Replace brake cylinder assembly if signs of pitting, scoring or cracks are evident.

Assembly

1. Apply a film of clean brake fluid to new L-type seals and then install seals onto pistons.
2. Apply a film of clean brake fluid to cylinder bore and piston assemblies. Carefully install one piston, the spring and then the other piston.
3. Install new dust covers.
4. Install brake cylinder assembly to brake backing plate with two (2) cap screws and lock washers. Torque cap screws from 49 to 97 in-lb (5.5 to 11 N-m).
5. Connect brake line to brake cylinder.
6. Reassemble brakes (see Brake Service in this section).
7. Bleed brakes (see Bleeding Brakes in this section).

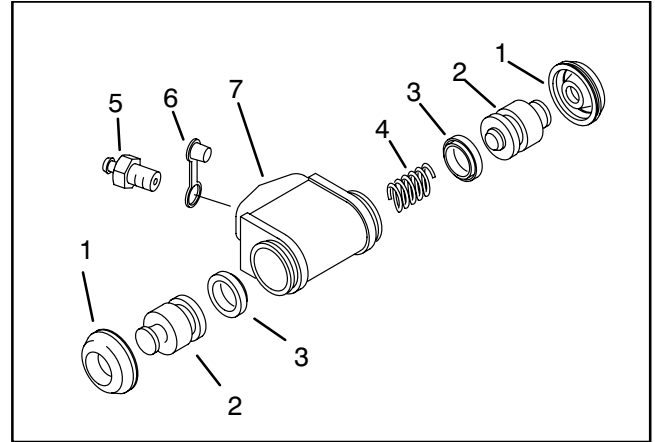


Figure 7

- | | |
|-------------------------|------------------------|
| 1. Dust cover (2 used) | 5. Bleed screw |
| 2. Piston (2 used) | 6. Bleed screw cap |
| 3. L-type seal (2 used) | 7. Brake cylinder body |
| 4. Spring | |

Bleeding the Brakes

1. Connect a suitable transparent hose to bleeder valve on right rear wheel cylinder and submerge other end of hose in a glass container partially filled with clean brake fluid.
2. Have a helper pump brake pedal several times, then hold pedal down firmly.
3. With pedal firmly depressed, open bleeder valve of right rear brake until pedal fades to floor, then close bleeder valve.
4. Repeat procedure until a continuous flow of brake fluid, with no air bubbles, is released from bleeder valve. **Make sure fluid level is maintained in brake fluid reservoir at all times.**
5. Complete steps 1 – 4 for left rear, right front and left front brakes.



CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

6. After bleeding of brakes is completed, road test vehicle to make sure brakes are operating correctly and pedal is solid.

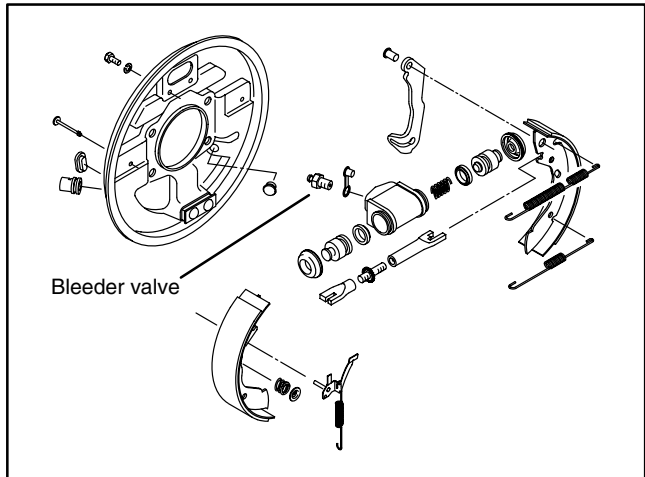


Figure 8

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Brake Master Cylinder

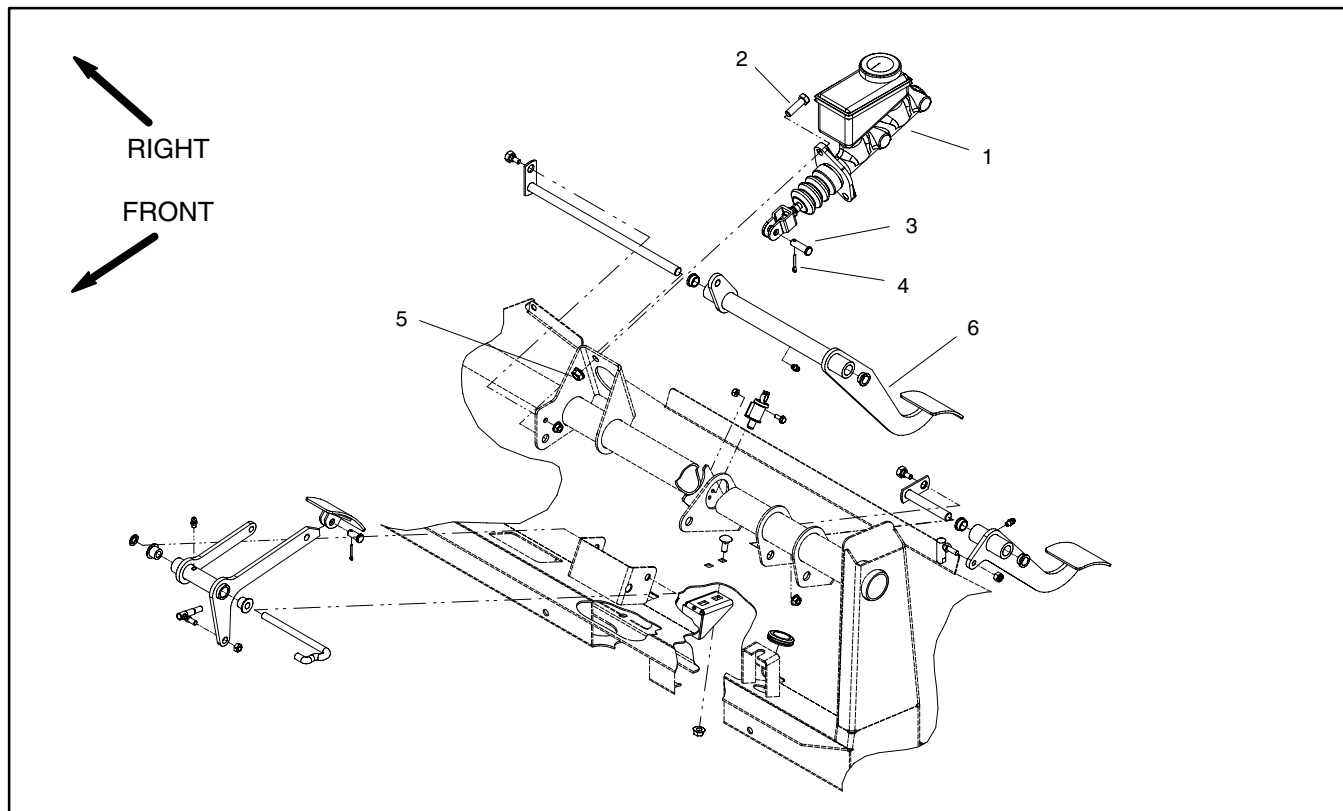


Figure 9

- 1. Brake master cylinder
- 2. Cap screw (2 used)

- 3. Clevis pin
- 4. Cotter pin

- 5. Flange nut (2 used)
- 6. Brake pedal

Removal (Fig. 9)

1. Remove cotter pin from the clevis pin that connects master cylinder to brake pedal.
2. Clean hydraulic brake line area of master cylinder to prevent contamination. Remove both brake lines from master cylinder. Cap ends of brake lines and position them away from master cylinder.
3. Remove two (2) cap screws and flange nuts that secure master cylinder to vehicle frame.
4. Pull master cylinder from vehicle.

Installation (Fig. 9)

1. Position master cylinder to vehicle frame and secure with two (2) cap screws and flange nuts.
2. Remove plugs from brake lines. Install brake lines to master cylinder.
3. Make sure that master cylinder push rod is fully extended. Connect push rod clevis to brake pedal with clevis pin and cotter pin.
4. Bleed brakes (see Bleed Brake System).



CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

5. Check brake operation.

Brake Master Cylinder Service

Disassembly (Fig. 10)

1. Remove reservoir and flange seal. Push in on the push rod so the stop pin can be removed.
2. Disconnect lower end of the dust cover from the housing.
3. Push in on the push rod and remove circlip, then remove push rod with dust cover and clevis. Remove retainer washer.
4. Remove primary piston assembly and secondary piston assembly from cylinder housing.

Inspection

1. Clean all metal parts with isopropyl alcohol, then clean out and dry grooves and passageways with compressed air. Make sure cylinder bore and component pieces are thoroughly clean.
2. Check cylinder bore, pistons, and springs for damage or excessive wear. Replace brake cylinder assembly if signs of pitting, scoring, or cracks are evident in cylinder bore.

Assembly (Fig. 10)

1. Apply a film of clean brake fluid to cylinder bore and piston assemblies.
2. Install secondary piston assembly and primary piston assembly into cylinder.
3. Install retainer washer.
4. Install push rod and secure in place with circlip. Install lower end of dust cover to housing.
5. Push in on push rod so stop pin can be installed to retain secondary piston assembly, then install flange seal and reservoir.

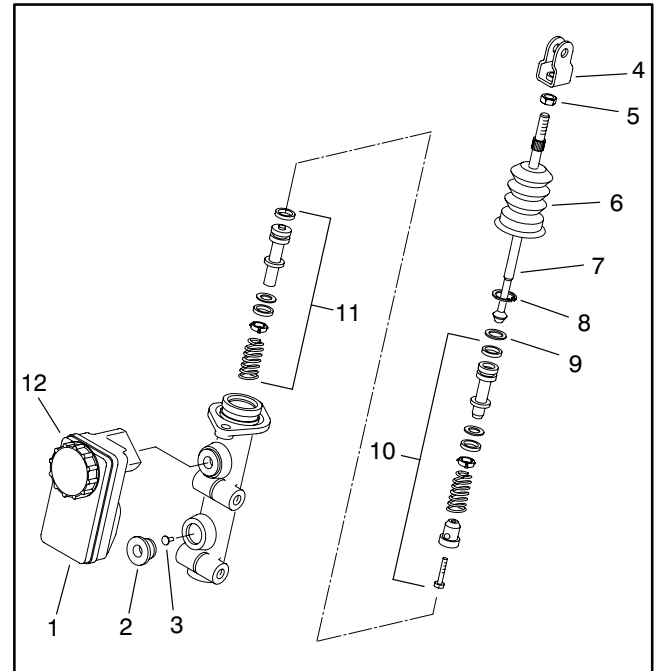


Figure 10

- | | |
|------------------------------|----------------------------|
| 1. Master cylinder reservoir | 7. Push rod |
| 2. Flange seal | 8. Circlip |
| 3. Stop pin | 9. Retainer washer |
| 4. Clevis | 10. Primary piston assy. |
| 5. Nut | 11. Secondary piston assy. |
| 6. Dust cover | 12. Cap assembly |

Parking Brake Cable Replacement

Removal (Fig. 11)

1. Remove brake handle from parking brake lever. Loosen set screw on parking brake control lever knob. Turn knob on parking brake lever counterclockwise all the way to loosen brake cable adjustment.

2. Remove knobs from control levers and then remove center console control plate to gain access to parking brake cables.

3. Jack up and support rear of vehicle (see Jacking Instructions in Operator's Manual).

4. Remove rear wheel and brake drum (see Brake Service in this section).

5. Disconnect cable from rear brake (Fig. 12):

A. Remove clip that holds brake cable into brake backing plate.

B. Remove parking brake cable end from parking brake lever on brake shoe.

6. Remove retaining ring that secures brake cable to lever support bracket (Fig. 11).

7. Disconnect brake cable from brake equalizer plate (Fig. 13).

8. Note routing of parking brake cable and location of cable ties used to secure brake cable. Remove brake cable from vehicle.

Installation (Fig. 11)

1. Connect brake cable to rear brake by inserting cable through brake backing plate and into parking brake lever. Install brake cable clip to secure cable to backing plate (Fig. 12).

2. After installing cable to rear brake, check to make sure bottoms of brake shoes are seated in grooves at bottom of backing plate.

3. Route brake cable in same location as before and secure with cable ties. Start from rear of vehicle and work towards front.

4. Install brake cable end to brake equalizer on parking brake lever. Secure brake cable to lever support bracket with retaining ring (Fig. 13).

5. Install rear brake drum and rear wheel (see Brake Service in this section).

6. Lower vehicle to ground.

7. Install center console control plate and control lever knobs.

8. Adjust parking brake lever (see Operator's Manual) and check operation of brakes before using the vehicle.

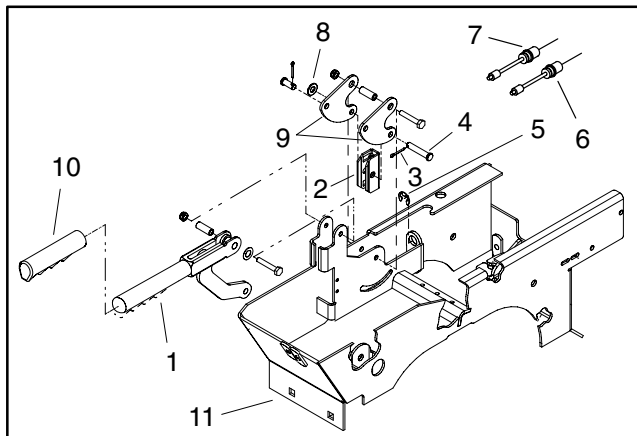


Figure 11

- | | |
|----------------------------|---------------------------|
| 1. Parking brake lever | 7. RH brake cable |
| 2. Cable equalizer bracket | 8. Washer |
| 3. Cotter pin | 9. Bellcrank |
| 4. Clevis pin | 10. Brake handle |
| 5. Retaining ring (2 used) | 11. Lever support bracket |
| 6. LH brake cable | |

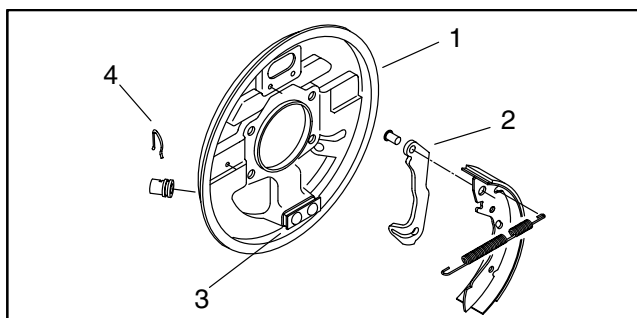


Figure 12

- | | |
|-----------------------------|-----------------------|
| 1. Rear brake backing plate | 3. Brake shoe grooves |
| 2. Parking brake lever | 4. Brake cable clip |

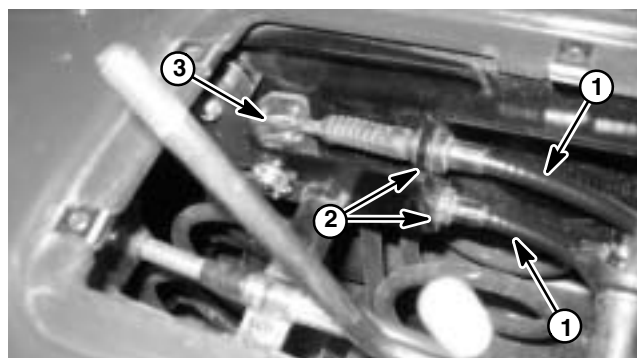


Figure 13

- | | |
|-------------------|----------------------|
| 1. Brake cable | 3. Equalizer bracket |
| 2. Retaining ring | |

Steering Wheel

Removal (Fig. 14)

1. Carefully remove steering wheel cover from steering wheel.
2. Remove hex nut and lock washer that secure steering wheel to steering control valve.
3. Pull steering wheel from control valve.

Installation (Fig. 14)

1. Apply anti-seize lubricant to shaft of control valve.
2. Slide steering wheel onto control valve shaft.
3. Secure steering wheel with lock washer and hex nut. Torque hex nut from 20 to 26 ft-lb (28 to 35 N-m).
4. Install steering wheel cover.

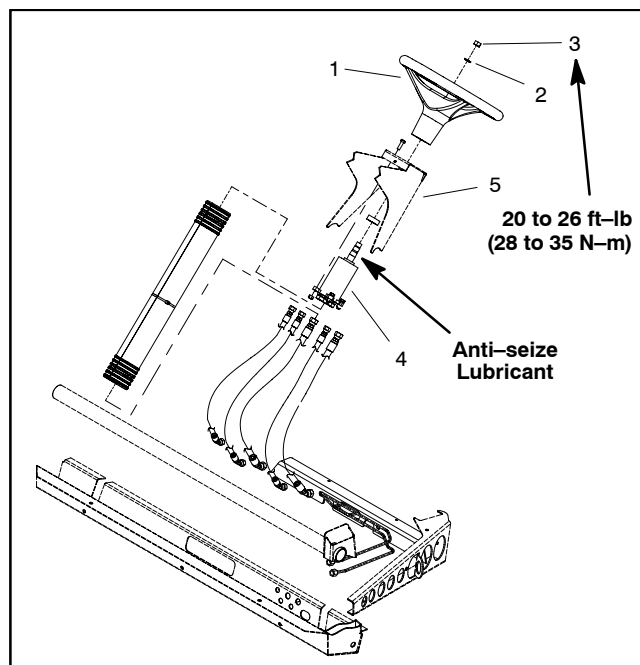


Figure 14

- | | |
|-------------------|---------------------------|
| 1. Steering wheel | 4. Steering control valve |
| 2. Lock washer | 5. Frame |
| 3. Hex nut | |

Control Arm Ball Joint Replacement

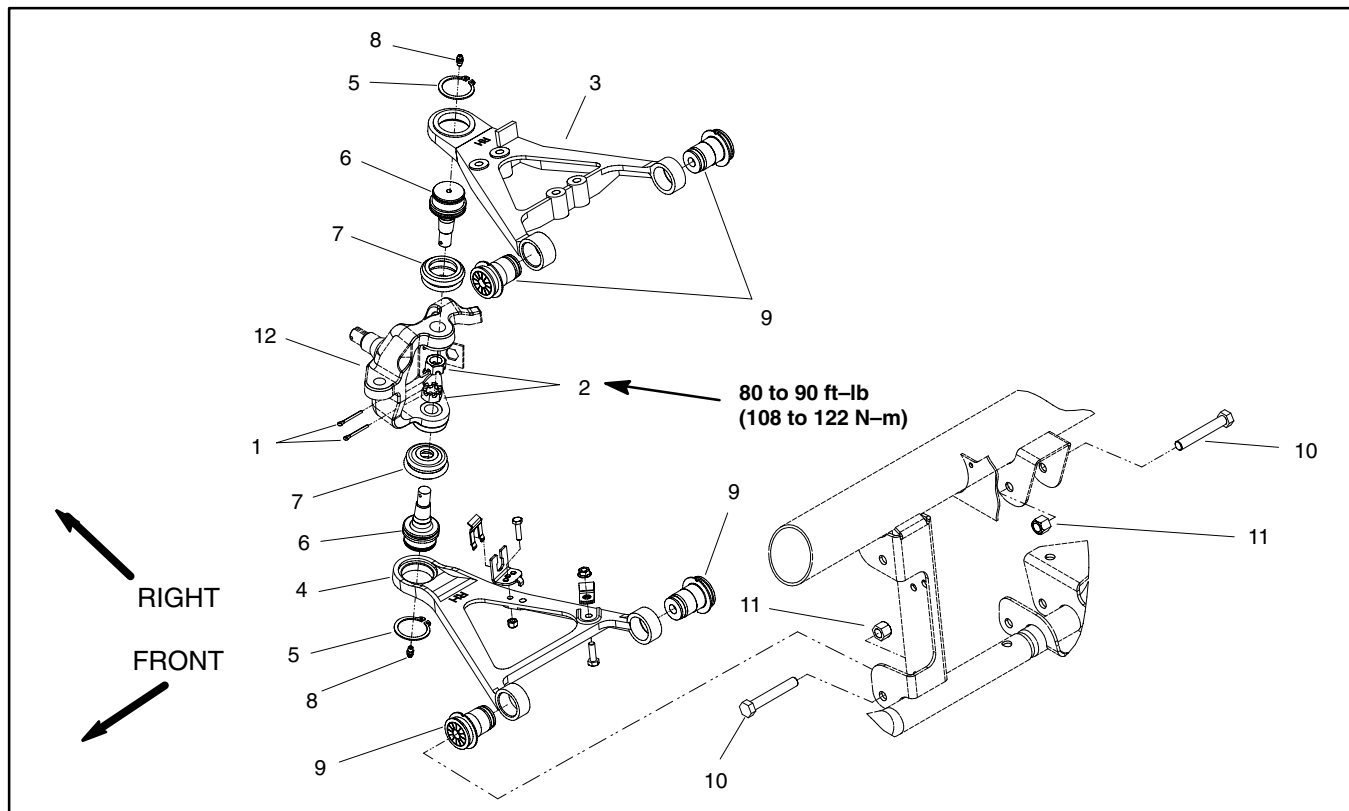


Figure 15

- | | | |
|---------------------------------|--------------------|-----------------------------|
| 1. Cotter pin | 5. Snap ring | 9. Flange bushing |
| 2. Slotted hex nut | 6. Ball joint | 10. Cap screw |
| 3. Upper control arm (RH shown) | 7. Ball joint seal | 11. Lock nut |
| 4. Lower control arm (RH shown) | 8. Grease fitting | 12. Spindle (RH, 2WD shown) |

Removal (Fig. 15)



WARNING

FRONT SUSPENSION IS SPRING LOADED! To prevent possible personal injury, use special tool to remove compression springs before disassembling the front suspension.

1. If servicing upper ball joint or control arm, remove front compression springs (see Front Compression Spring Service in this section). **NOTE:** Front compression springs do not need to be removed if servicing only the lower ball joint or lower control arm.
2. Remove cotter pin and slotted nut that secure affected ball joint to spindle. Separate ball joint from spindle. Inspect ball joint seal and replace if damaged.
3. Remove control arm.
4. Remove snap ring. Press ball joint out of control arm.

Installation (Fig. 15)

1. Press new ball joint into control arm. Install snap ring to secure ball joint.
2. Install grease fitting into ball joint. Install boot over shaft on ball joint. Edge of boot must be inserted into ball joint slot.
3. Install and secure control arm to vehicle with cap screws and lock nuts. Make sure frame tabs collapse against rubber bushings as control arm fasteners are tightened.
4. Secure ball joint to spindle with slotted nut. Tighten slotted nut to a torque from 80 to 90 ft-lb (108 to 122 N-m). If necessary to install cotter pin, tighten nut further and secure assembly with cotter pin.
5. If removed, install front compression springs (see Front Compression Spring Service in this section).
6. Grease ball joint (see Operator's Manual).

Tie Rod End Replacement

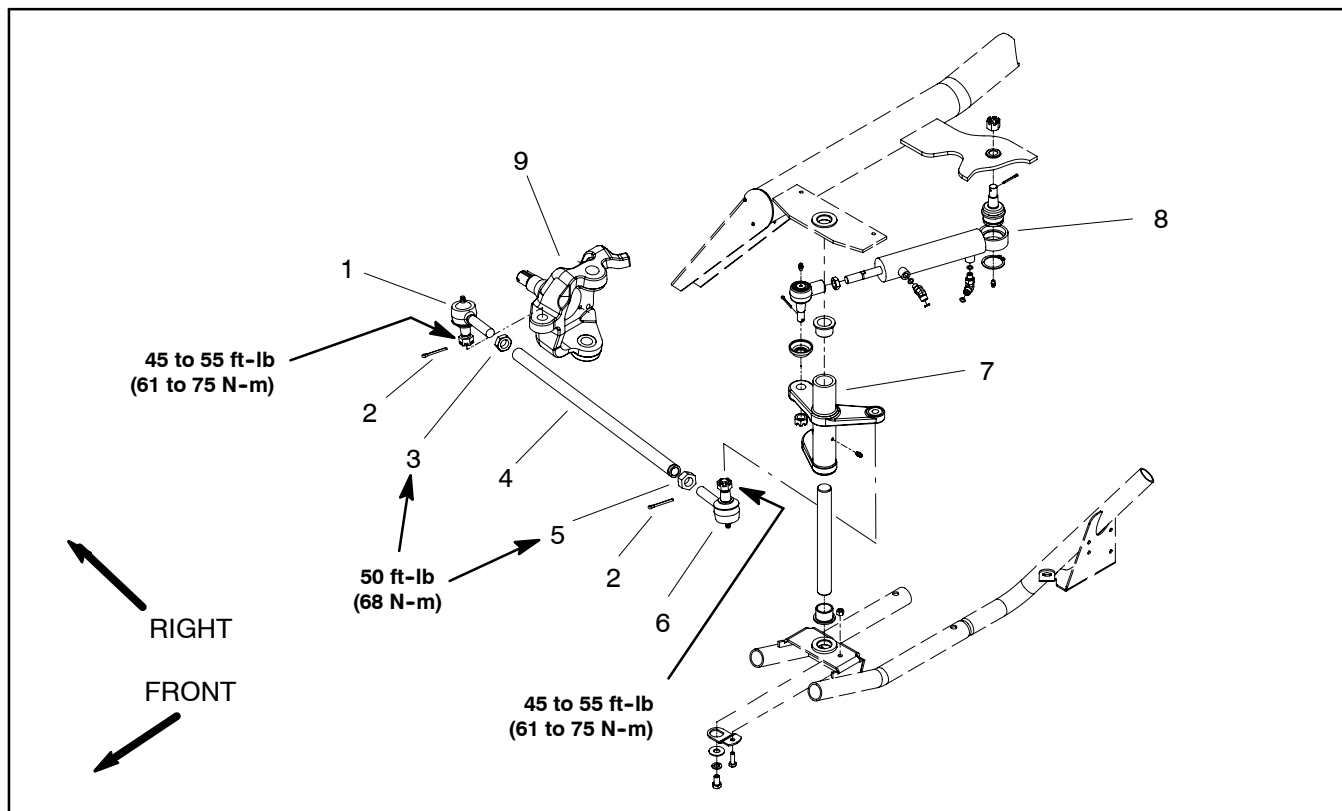


Figure 16

1. Tie rod end
2. Cotter pin
3. Jam nut

4. Tie rod
5. Jam nut (LH thread)
6. Tie rod end (LH thread)

7. Pitman arm
8. Steering cylinder
9. Spindle (RH shown)

Removal (Fig. 16)

1. Loosen jam nut that secures affected tie rod end to tie rod.
2. Remove cotter pin and slotted nut from affected tie rod end.
3. Use a suitable puller to disconnect rod end from spindle or pitman arm.
4. Remove tie rod end from tie rod. Count the number of revolutions it takes to remove rod end so new rod end can be installed without changing the toe-in adjustment.

Installation (Fig. 16)

1. Install new tie rod end to tie rod. Thread in the same number of revolutions as the old one took to remove.
2. Make sure that tie rod end shaft and spindle or pitman arm are thoroughly cleaned.
3. Insert tie rod end shaft to spindle or pitman arm and secure with slotted nut. Tighten slotted nut to a torque from 45 to 55 ft-lb (61 to 75 N-m). If necessary to install cotter pin, tighten nut further and secure assembly with cotter pin.
4. Tighten jam nut to secure tie rod end to tie rod. Torque jam nuts to 50 ft-lb (68 N-m) after adjustment is complete. Make sure that the tie rod ends are aligned with each other as the jam nuts are being tightened.
5. Check front wheel alignment (see Front Wheel Alignment in this section). Adjust as necessary.
6. Grease tie rod end (see Operator's Manual).

Front Wheel Alignment

1. Before inspecting or adjusting front wheel alignment, check that when fully retracted, the steering cylinder has a length as shown in Figure 17. If the retracted cylinder length is incorrect, see Steering Cylinder Installation in Service and Repair section of Chapter 9 - Hydraulic System for steering cylinder ball joint installation procedure.

2. With steering cylinder mounted in vehicle, rotate steering wheel to extend steering cylinder to a length of 17.320" (43.99 cm) between the centers of the cylinder ball joints (Fig. 18). This steering cylinder length will center the Pitman arm with the vehicle to ensure correct front wheel alignment measurement.

3. With the Pitman arm centered, measure center to center distance (at axle height) between the front wheels at both front and rear of the wheels (Fig. 19). The front measurement must be 0.125 to 0.375 inch (3.18 to 9.53 mm) greater than the rear measurement (toe-out).

4. If adjustment is needed, loosen jam nuts on front tie rod ends and rotate tie rod(s) to change alignment. Torque jam nuts to 50 ft-lb (68 N-m) after adjustment is complete. Make sure that the tie rod ends are aligned with each other as the jam nuts are being tightened.

5. After alignment has been checked and/or adjusted, check for component interference as steering wheel is turned from lock to lock.

A. If a tie rod contacts the Pitman arm, adjust steering cylinder ball joint location.

B. If tie rod ends contact spindles, adjust both tie rods equally to re-center steering.

C. After any adjustment, re-check front wheel alignment. Additionally, make sure that all jam nuts are properly torqued.

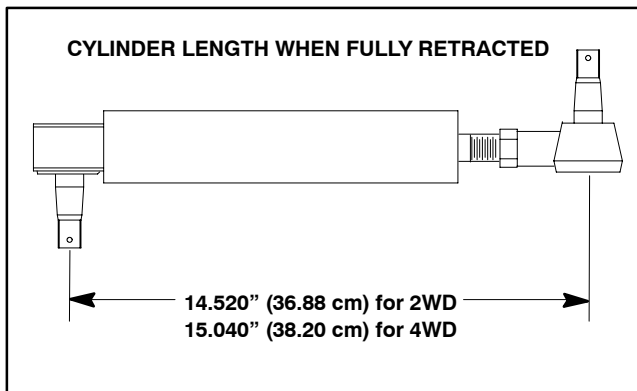


Figure 17

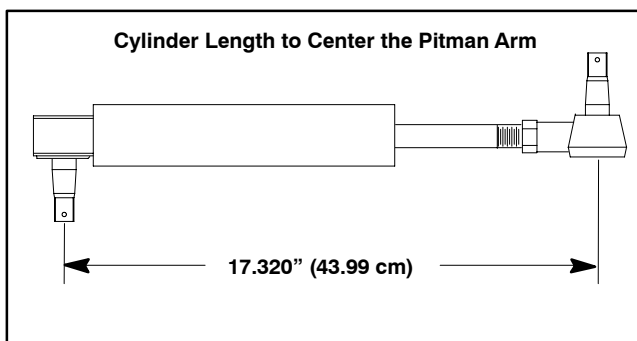


Figure 18

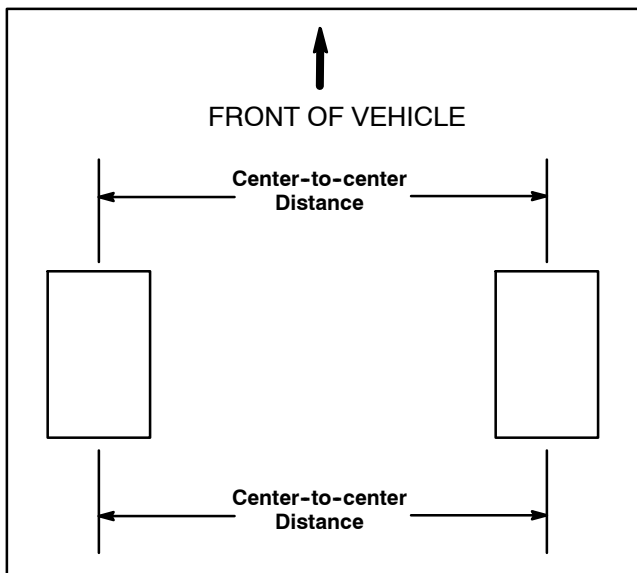


Figure 19

Front Compression Spring Service

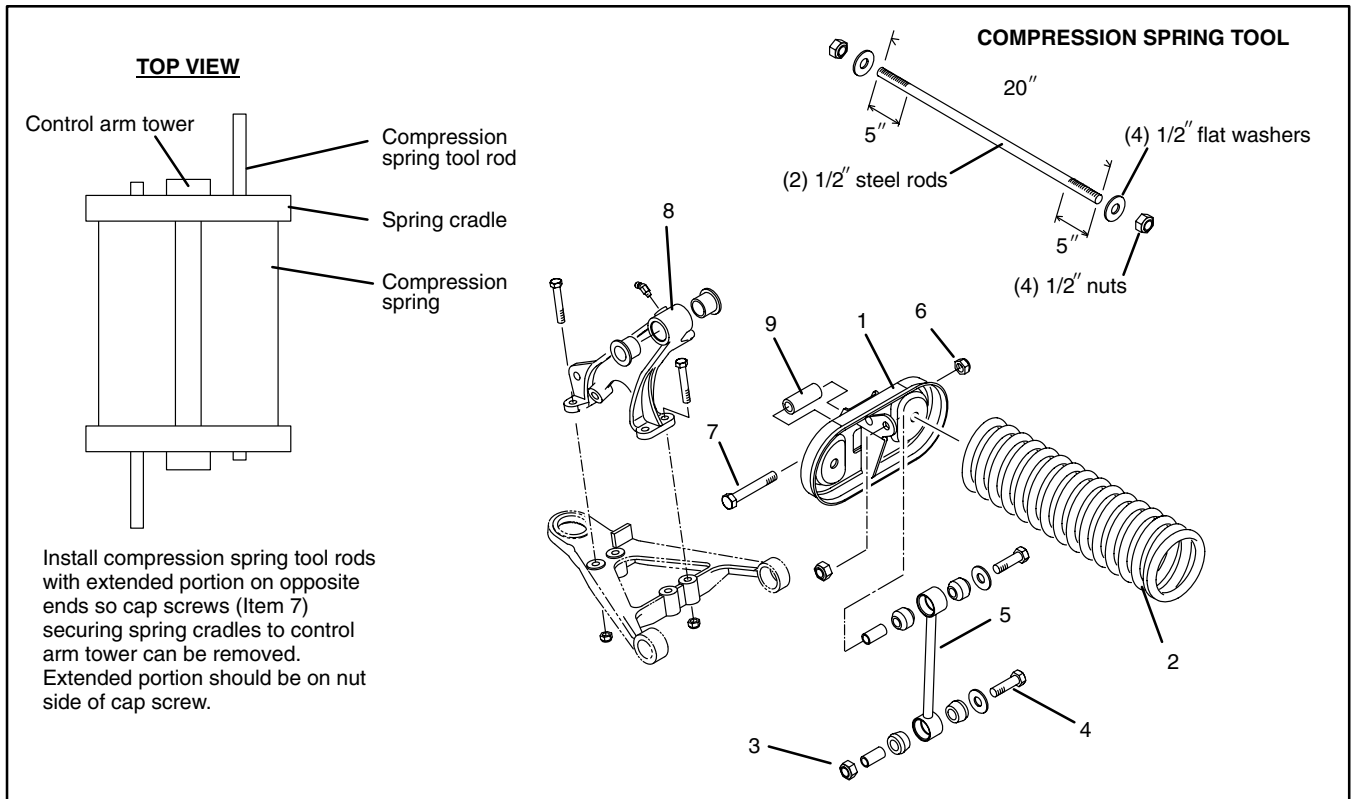


Figure 19

1. Spring cradle
2. Spring
3. Lock nut

4. Cap screw
5. Stabilizer link
6. Lock nut

7. Cap screw
8. Control arm tower
9. Spring pivot sleeve

1. Remove seat base to gain access to front suspension assembly (see Seat Base removal in this section).
2. Jack up front of vehicle and secure with jack stands (see Jacking Instructions in Operator's Manual). Remove front wheels.
3. Remove front shock absorbers.

6. Remove lock nut (Item 6) and cap screw (Item 7) securing each spring cradle to control arm towers (Item 8), then remove springs and cradles along with the stabilizer links.

7. Reverse this procedure to install springs.



WARNING

FRONT SUSPENSION IS SPRING LOADED! To prevent possible personal injury, use special tool to remove compression springs before disassembling the front suspension.

4. Install a compression spring tool rod through holes in each spring cradle (Item 1), then install nuts and washers on both ends of each rod. Tighten one nut on each rod to secure springs (Item 2). **NOTE:** Extended portion of each compression spring tool must be on opposite ends so cap screws (Item 7) can be removed.

5. Remove lock nut (Item 3) and cap screw (Item 4) from lower end of each stabilizer link (Item 5).

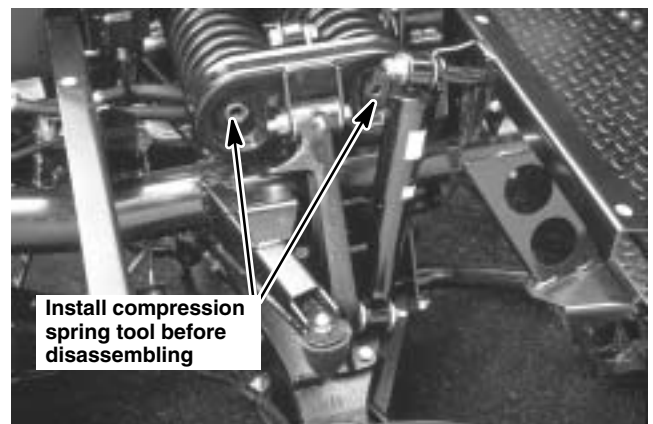


Figure 20

Front Shock Absorber Replacement

1. Remove lower and upper lock nuts, then remove shock absorber and washers. Note that washers on upper end of shock absorber are different. Washers on lower end of shock are identical.

2. Insert two (2) new rubber bushings into each end of new shock absorber. Insert spacer into ram (lower) end of shock absorber.

3. Install inner washer onto stud above control arm.

4. Install new shock absorber with ram end down and secure upper end with outer washer and lock nut.

5. Insert capscrew down through angled hole in control arm tower. Install washer onto cap screw and slide shock absorber onto cap screw. Install second washer onto capscrew and secure with lock nut.

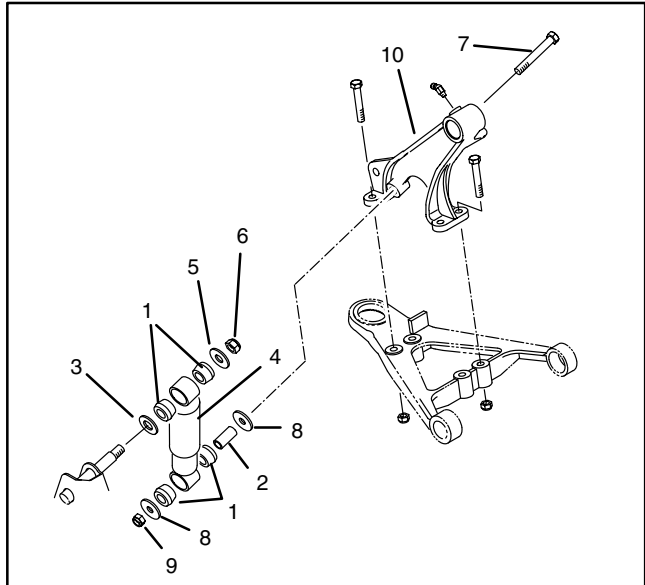


Figure 21

- | | |
|-------------------|-----------------------|
| 1. Rubber bushing | 6. Lock nut |
| 2. Spacer | 7. Cap screw |
| 3. Inner washer | 8. Washer |
| 4. Shock absorber | 9. Lock nut |
| 5. Outer washer | 10. Control arm tower |

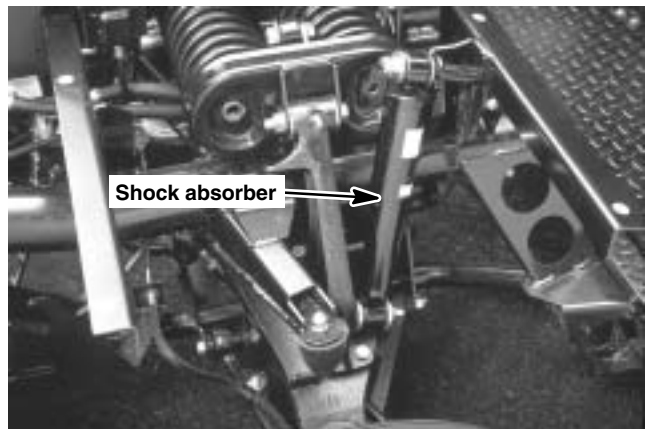


Figure 22

Rear Shock Absorber Replacement

1. Remove lower and upper lock nuts, then remove shock absorber and washers from vehicle.
2. Insert two (2) new rubber bushings into each end of new shock absorber.
3. Install one large washer onto each shock absorber mounting stud.
4. Install new shock absorber with ram end down. Secure each end with with large washer and lock nut.

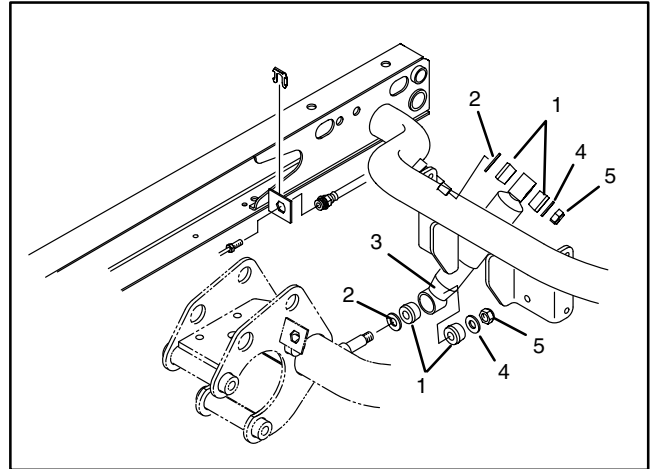


Figure 23

- | | |
|-------------------|-----------------|
| 1. Rubber bushing | 4. Large washer |
| 2. Large washer | 5. Lock nut |
| 3. Shock absorber | |

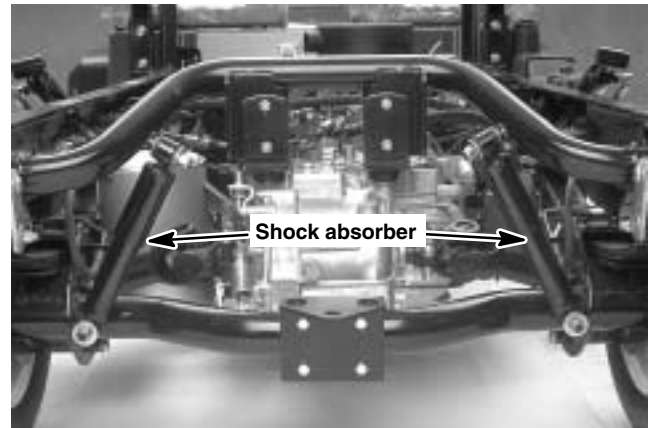


Figure 24

Rear Leaf Spring Replacement

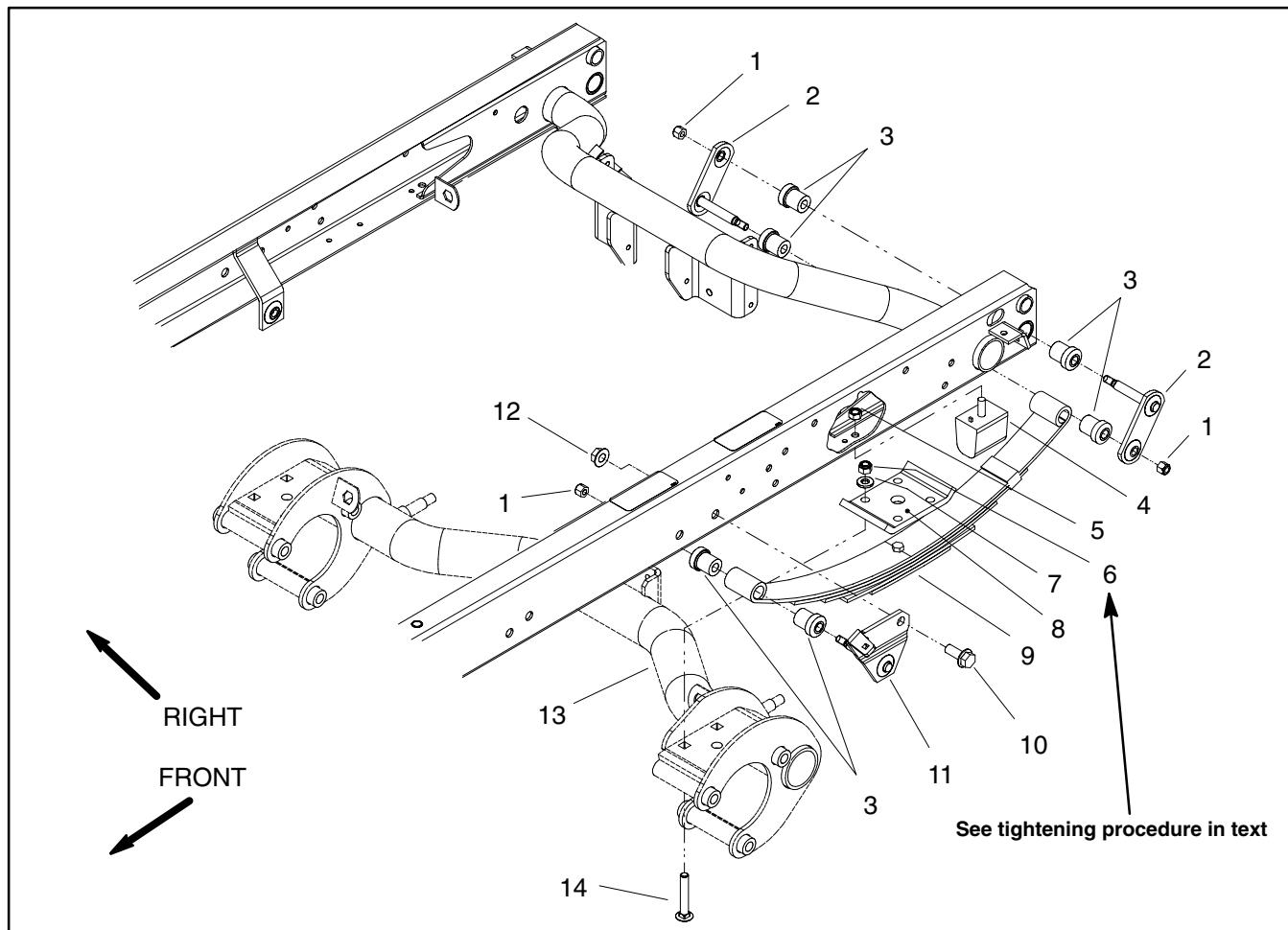


Figure 25

- | | | |
|-------------------|-------------------------------------|--|
| 1. Lock nut | 6. Lock nut (4 used per spring) | 11. Spring mount |
| 2. Spring shackle | 7. Washer (4 used per spring) | 12. Flange nut (2 per mount) |
| 3. Rubber bushing | 8. Spring plate | 13. Rear axle |
| 4. Axle bumper | 9. Leaf spring | 14. Carriage screw (4 used per spring) |
| 5. Hex nut | 10. Flange head screw (2 per mount) | |

IMPORTANT: For proper vehicle performance, always replace the springs on both sides of the vehicle.

Removal (Fig. 25)

1. Jack up and support rear of vehicle (See Jacking Instructions in Operator's Manual). Remove rear wheel(s).
2. Support frame side rails so rear axle can be removed.

3. Support rear axle, then remove four (4) lock nuts (Item 6), washers (Item 7) and carriage screws (item 14) securing rear axle to leaf spring.

4. Remove two (2) lock nuts (Item 1) from spring shackles (Item 2). Remove spring shackles.

5. Remove two (2) flange nuts (Item 12) and flange head screws (Item 10) securing spring mount (Item 11) to frame rail, then remove leaf spring assembly.

Installation (Fig. 25)

1. Before installing new leaf spring, insert four (4) rubber bushings (Item 3) into leaf spring. Insert two (2) rubber bushings into frame side rail.

2. Insert one (1) spring shackle (Item 2), from inside/out, into rear of leaf spring. Insert spring mount (Item 11), from outside/in, to front of leaf spring and secure, finger tight, with lock nut.

3. Install leaf spring assembly to frame. Secure front spring mount with flange head screws (Item 10) and flange nuts (Item 12) and tighten finger tight. Install lock nuts (Item 1) to spring shackles (Item 2) and tighten finger tight. Tighten lock nuts (Item 6). Leave flange nuts (Item 12) that secure spring mount to frame rail finger tight.

4. Install spring plate (Item 8) to top of spring, then secure axle to spring with carriage bolts (Item 14), washers (Item 7) and lock nuts (Item 6). **NOTE:** Make sure axle and plate are centered on leaf spring knob (Fig. 26).

5. Tighten lock nuts (Item 6) in a crossing pattern until spring plate, leaf spring and axle contact. Tighten flange nuts (Item 12) securing spring mount to frame rail. Tighten lock nuts (Item 6) securing axle and clamp plate to leaf spring using a crossing pattern and the following torque values:

A. Tighten lock nuts from 20 to 30 ft-lb (27 to 41 N-m) in a crossing pattern.

B. Tighten lock nuts from 50 to 60 ft-lb (68 to 81 N-m) in a crossing pattern.

C. Retighten lock nuts from 50 to 60 ft-lb (68 to 81 N-m).

6. Install rear wheels (see Wheel Installation in this section).

7. Lower vehicle to ground.

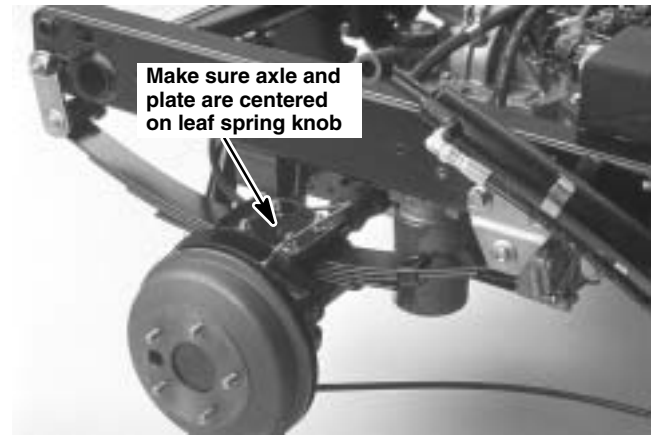


Figure 26

Seat Base

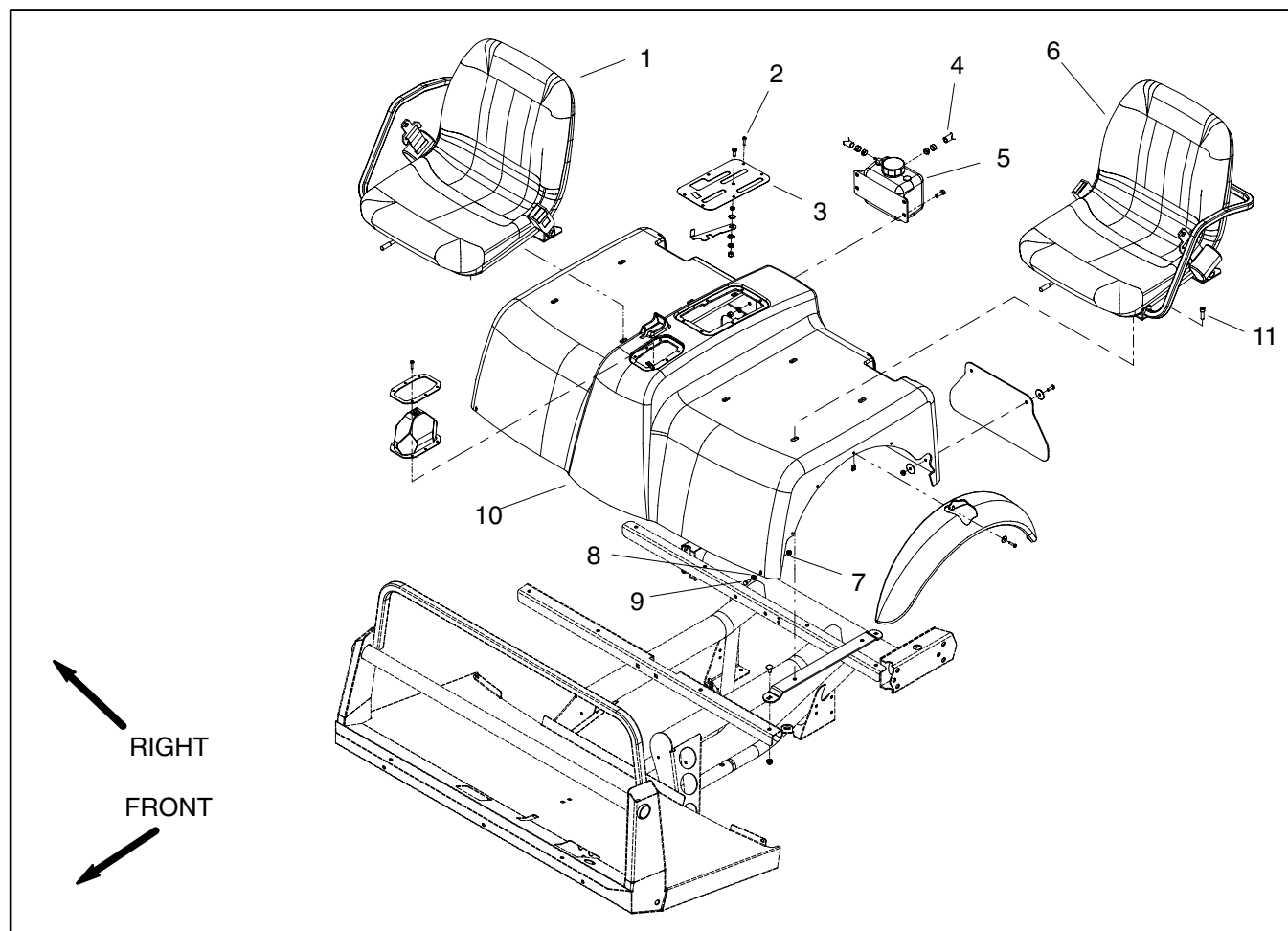


Figure 27

- | | | |
|---------------------|----------------------|---|
| 1. Passenger seat | 5. Coolant reservoir | 9. Cap screw |
| 2. Screw (6 used) | 6. Operator seat | 10. Seat base |
| 3. Control plate | 7. Lock nut | 11. Socket head screw (4 used per seat) |
| 4. Hose to radiator | 8. Flat washer | |

Removal (Fig. 27)

1. Park vehicle on a level surface, raise and support bed (if installed), shut engine off and engage the parking brake.
2. Remove ROPS from vehicle (Fig. 28)
3. Remove knobs from control levers, then remove center console control plate assembly.
4. Remove four (4) socket head screws that secure each seat to vehicle. Lift both seats from vehicle.
5. Remove cap screw, flat washer and lock nut that secure each front corner of seat base to frame.
6. Disconnect radiator overflow tank hose at radiator and plug the hose.
7. Carefully lift seat base from vehicle.

Installation (Fig. 27)

1. Position and secure seats and seat base to vehicle with removed fasteners.
2. Reconnect radiator overflow tank hose to radiator.
3. Secure center console control plate to vehicle. Install knobs on control levers.
4. Install ROPS to vehicle with four (4) cap screws and flange nuts (Fig. 28).

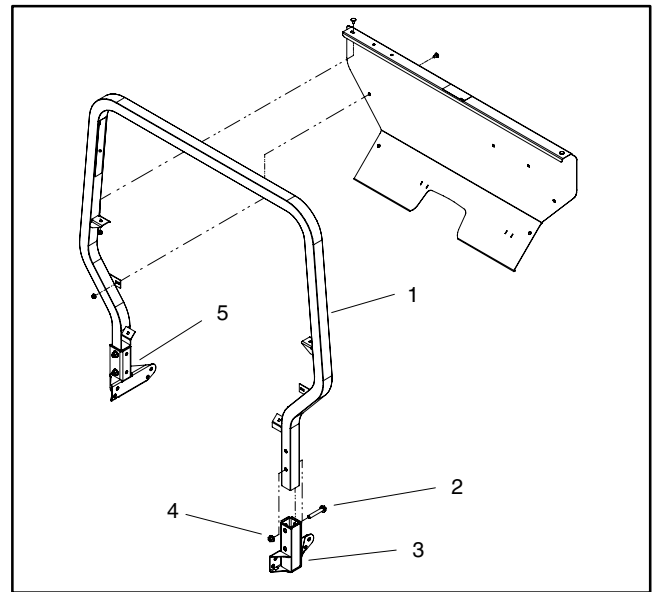


Figure 28

- | | |
|-----------------------|------------------------|
| 1. ROPS frame | 4. Flange nut (4 used) |
| 2. Cap screw (4 used) | 5. RH ROPS receiver |
| 3. LH ROPS receiver | |

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Electrical System

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Electrical Schematics

The electrical schematics for the Workman are located in Chapter 11 – Electrical Schematics.

Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local supplier.

Continuity Tester

Battery powered test lamp which is helpful in testing for continuity of circuits and electrical components when the current is off.

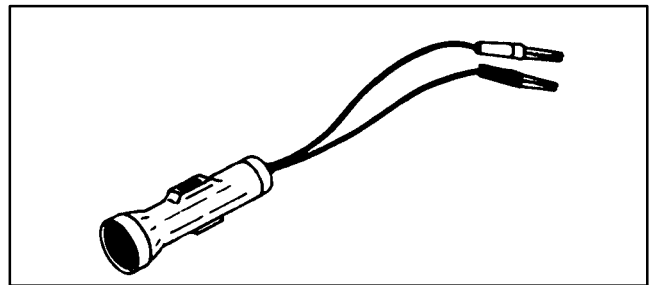


Figure 1

Multimeter

The meter can test electrical components and circuits for current, resistance, or voltage.

NOTE: Toro recommends the use of a DIGITAL Volt-Ohm-Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

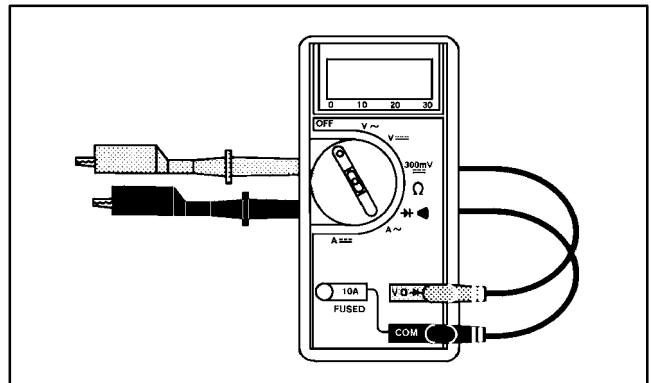


Figure 2

Skin-Over Grease

Special non-conductive grease (Toro Part No. TOR50547) which forms a light protective skin which helps waterproof electrical switches and contacts.



Figure 3

Troubleshooting



CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this vehicle (see Vehicle Electrical Schematics in Chapter 11).

If the vehicle has any interlock switches by-passed, they must be reconnected for proper troubleshooting and safety.

Condition	Possible Cause
Starter cranks, but should not, with clutch pedal released.	Clutch switch out of adjustment or faulty.
Starter cranks, but should not, with PTO engaged.	PTO switch faulty.
Starter solenoid clicks, but starter will not crank. (If solenoid clicks, problem is not in interlock system.)	Low battery charge. Loose or corroded battery cables or ground. Loose, corroded or damaged wiring at starter. Loose starter mounting bolts. Faulty starter. Faulty starter solenoid.
Starter cranks but engine will not start.	3rd–High lockout key switch in Slow position with transaxle in 3rd gear and High range – instruct operator. "I" terminal wire of ignition key switch loose, corroded or damaged. Engine or fuel system problem (see appropriate Engine chapter).
Engine does not shut off immediately when ignition key switch is turned off (Workman 3100 only).	Damaged or disconnected wiring for shut–down relay. Shut–down relay faulty.

Condition	Possible Cause
Nothing happens when start attempt is made.	<p>Clutch pedal not depressed – instruct operator.</p> <p>PTO engaged – instruct operator.</p> <p>Low battery charge.</p> <p>Loose or corroded battery cables. Loose or corroded ground.</p> <p>"RUN" fuse open.</p> <p>Fusible link open.</p> <p>Clutch cable out of adjustment.</p> <p>Clutch switch out of adjustment or faulty.</p> <p>Clutch switch wiring loose, corroded or damaged.</p> <p>Rear PTO switch (if equipped) faulty.</p> <p>Rear PTO switch (if equipped) wiring loose, corroded or damaged.</p> <p>Faulty ignition key switch.</p> <p>Ignition switch wiring loose, corroded or damaged.</p> <p>Start relay faulty.</p> <p>Start relay wiring loose, corroded or damaged.</p> <p>Starter solenoid wiring loose, corroded or damaged.</p> <p>Starter solenoid faulty.</p>
Engine runs, but should not, with 3rd–High lockout switch in Slow position and transaxle in 3rd gear and High range.	<p>3rd–High lockout key switch faulty.</p> <p>2–3 lockout switch on transaxle faulty.</p> <p>High–Low lockout switch on transaxle faulty.</p>
Engine kills when shifted to 3rd gear.	<p>3rd–High lockout key switch on Slow position with transaxle in High range – instruct operator.</p> <p>Damaged or disconnected wiring for 3rd–High lockout key switch.</p> <p>Damaged or disconnected wiring for 2–3 lockout switch or High–Low switch on transaxle.</p>
Battery does not charge.	<p>Loose or broken wire(s).</p> <p>Faulty alternator.</p> <p>Dead battery.</p>

Electrical System Quick Checks

Battery Test (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals.

Set the multimeter to the DC volts setting. The battery should be at a temperature of 60° to 100° F (16° to 38° C). The ignition key should be in the OFF position and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post.

NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information (see Battery Service in Service and Repairs section of this Chapter).

Voltage Measured	Battery Charge Level
12.68 v (or higher)	Fully charged (100%)
12.45 v	75% charged
12.24 v	50% charged
12.06 v	25% charged
11.89 v	0% charged

Charging System Test

This is a simple test used to determine if a charging system is functioning. It will tell you if a charging system has an output, but not its capacity.

Use a multimeter set to the DC volts setting. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post. Leave the test leads connected and record the battery voltage.

NOTE: Upon starting the engine, the battery voltage will drop and then should increase once the engine is running.

NOTE: Depending upon the condition of the battery charge and battery temperature, the charging system voltage will increase at different rates as the battery charges.

Start the engine and run at high idle. Allow the battery to charge for at least 3 minutes. Record the battery voltage.

Test results should be (example):

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.80 v
Difference	= +0.50 v

Verify Interlock System Operation

The purpose of the interlock system is to prevent the engine from cranking or starting unless the clutch pedal is depressed (all models), the hydraulic lift lever is in the neutral position (TC models) and rear PTO (if so equipped) is disengaged.



CAUTION

Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine.

To verify clutch interlock switch operation:

1. Sit on operator's seat and engage parking brake. Move shift lever to NEUTRAL position. On TC models, make sure that hydraulic lift lever is in neutral position. Disengage rear PTO (if so equipped).
2. Without depressing clutch pedal, rotate ignition key clockwise to START position.
3. If engine cranks or starts, there is a malfunction in the interlock system that must be repaired before operating vehicle.

To verify operation of hydraulic lift interlock switch (TC models):

1. Sit on operator's seat and engage parking brake. Move shift lever to NEUTRAL position. Disengage rear PTO (if so equipped).
2. Move hydraulic lift lever out of neutral position.
3. Depress clutch pedal and rotate ignition key clockwise to START position.
4. If engine cranks or starts, there is a malfunction in the interlock system that must be repaired before operating vehicle.

To verify rear PTO interlock switch (if equipped) operation:


1. Sit on operator's seat and engage parking brake. Move shift lever to NEUTRAL position. On TC models, make sure that hydraulic lift lever is in neutral position.
2. Engage rear PTO.
3. Depress clutch pedal and rotate ignition key clockwise to START position.
4. If engine cranks or starts, there is a malfunction in the interlock system that must be repaired before operating vehicle.

Component Testing

This section will define given components, and the tests that can be performed on those components, when those parts are disconnected from the electrical system.

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the clutch switch connector before doing a continuity check).

NOTE: Electrical troubleshooting of any 12 Volt power connection can also be performed through voltage drop tests without disconnection of the component.

**CAUTION**

When testing electrical components for continuity with a volt-ohm meter or continuity tester, make sure that power to the circuit has been disconnected.

Ignition Key Switch

The ignition key switch has three positions (OFF, START and RUN). The terminals are marked as shown in Figure 4. The circuitry of the ignition switch is shown in the chart (Fig. 5). With the use of a continuity tester, the switch functions may be tested to determine whether all circuits are being completed while the key is moved to each position.

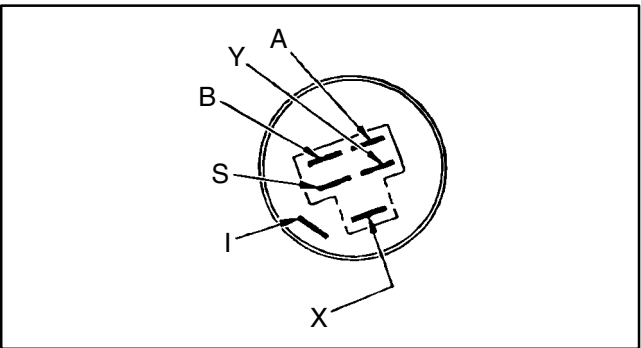


Figure 4

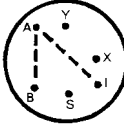
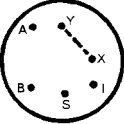
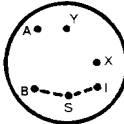
POSITION	CONTINUITY AMONG TERMINALS	OTHER CIRCUITS MADE
1. OFF	NONE	NONE
2. RUN	 B+A+I	 X+Y
3. START	 B+S+I	NONE

Figure 5

Clutch Switch

The clutch switch is normally open and closes when the clutch pedal is depressed. The clutch switch is attached to a bracket on the left side of the clutch bell housing (Fig. 6).

Test the switch by disconnecting the wiring connector and connecting a continuity tester across the two terminals. With the engine off, depress the clutch pedal completely – there should be an indication of continuity. Release the clutch pedal – there should be no continuity.

For clutch switch adjustment procedure, see Clutch Pedal Adjustment in Chapter 6 – Drive Train.

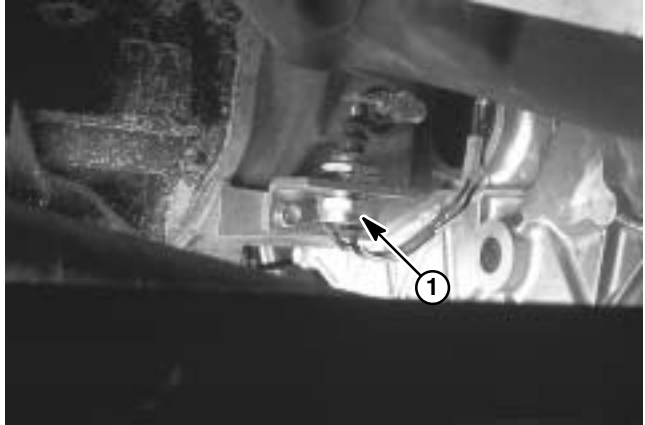


Figure 6

1. Clutch switch

Brake Switch

The brake switch is normally open and closes when the brake pedal is depressed. The closed switch allows a current path to the stop light.

Test the switch by disconnecting the wiring connector and connecting a continuity tester across the two terminals. With the engine off, depress the brake pedal – there should be an indication of continuity. Release the brake pedal – there should be no continuity.

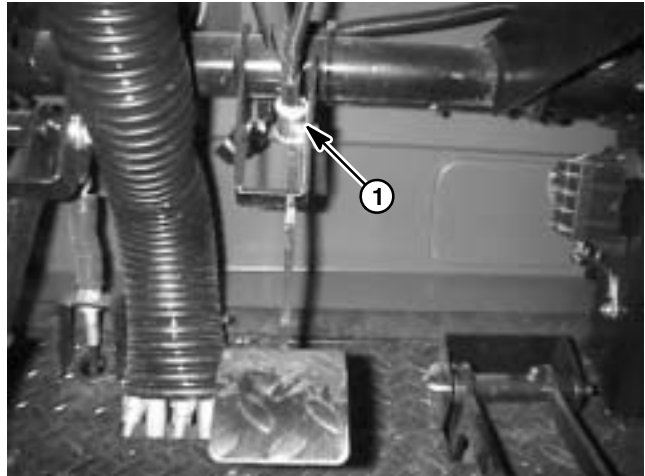


Figure 7

1. Brake switch

Transaxle Lockout Switches

2–3 Lockout Switch

The transaxle 2–3 Lockout switch is closed in 2nd gear and open in 3rd gear.

Test the switch by disconnecting the wiring connector and connecting a continuity tester across the two terminals. With the engine off, move transmission shifter to 2nd gear – there should be an indication of continuity. Move shifter to 3rd gear – there should be no continuity.

High–Low Lockout Switch

The transaxle High–Low Lockout switch is closed in Low range and open in High range.

Test the switch by disconnecting the wiring connector and connecting a continuity tester across the two terminals. With the engine off, move shifter to Low range – there should be an indication of continuity. Move shift lever to High range – there should be no continuity.

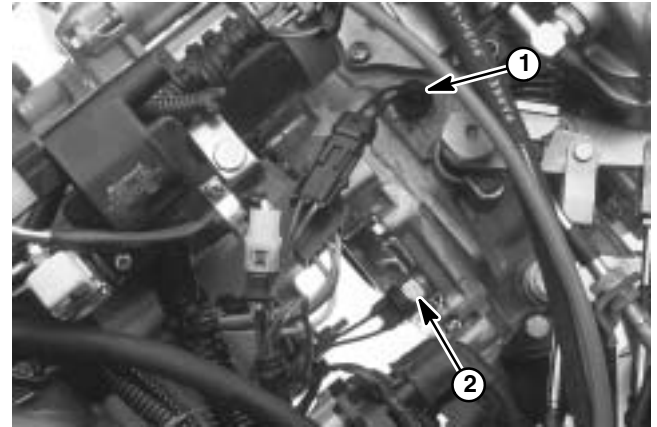


Figure 8

1. 2–3 lockout switch

2. Hi–Low lockout switch

3rd–High Lockout Key Switch

The 3rd–High Lockout switch is closed in Fast position and open in Slow position.

Test the switch by disconnecting the wiring and connecting a continuity tester across the two terminals. With the engine off, move key to Fast position – there should be an indication of continuity. Move key to Slow position – there should be no continuity.



Figure 9

Start (Briggs/Daihatsu Gas and Diesel Engine) and Fuel Pump (Briggs/Daihatsu Gas Engine) Relay

The start relay used on Workman vehicles with a Briggs/Daihatsu gasoline or diesel engine and the fuel pump relay on Workman vehicles with a Briggs/Daihatsu gasoline engine are identical. These relays are attached to the frame near the hydraulic oil filter.

Testing

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Disconnect the harness connector from the relay that is to be tested.
2. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 10). Resistance should be between 70 and 90 ohms.
3. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.
4. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.
5. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87A as +12 VDC is applied and removed from terminal 85.
6. Disconnect voltage and multimeter leads from the relay terminals. Reconnect relay to vehicle wire harness.

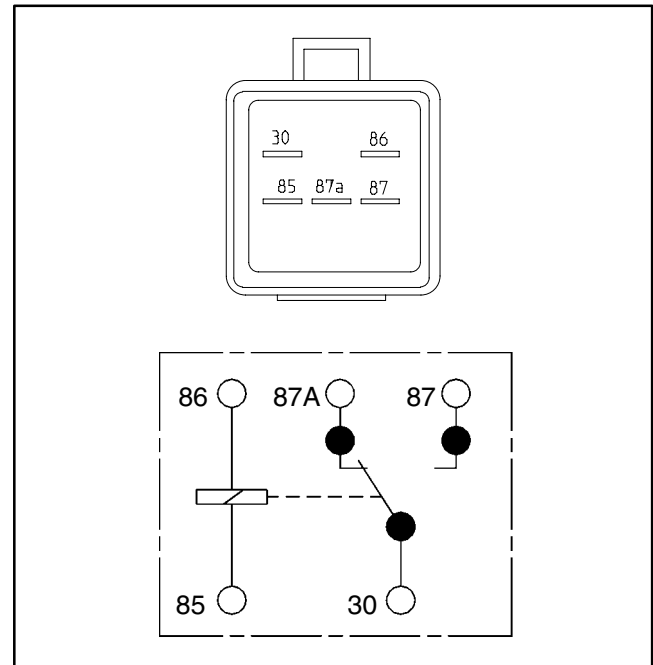


Figure 10

Glow Relay (Briggs/Daihatsu Diesel Engine)

On Workman vehicles with a diesel engine, the glow relay is attached to the the hydraulic oil filter bracket.

Two styles of glow relays have been used on the Workman. On machines with serial numbers below 260000000, two of the four relay connections are secured with screws (Fig. 11). On machines with serial numbers above 260000000, the glow relay is attached to the wire harness with a four wire connector (Fig. 12).

1. Verify coil resistance between terminals 86 and 85 with a multimeter (ohms setting).

A. On machines with serial numbers below 260000000, resistance should be from 41 to 51 ohms.

B. On machines with serial numbers above 260000000, resistance should be approximately 72 ohms.

2. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

3. Disconnect voltage and leads from the terminals.

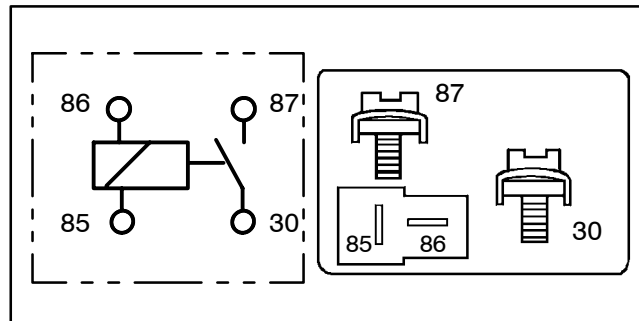


Figure 11

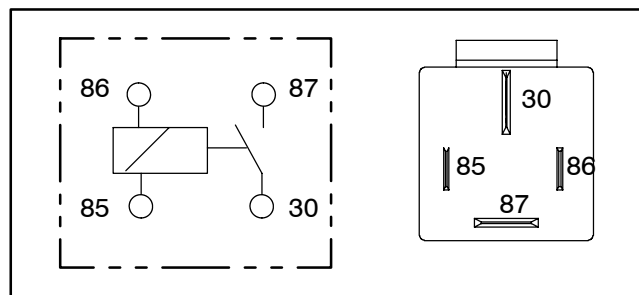


Figure 12

Start Relay (Kohler Engine)

The start relay used on Workman vehicles with a Kohler engine is attached to the frame near the hydraulic oil filter.

Testing

1. Disconnect the harness connector from the relay that is to be tested.

2. Connect multimeter (ohms setting) leads to relay terminals 30 and 87 (Fig. 13). Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

3. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.

4. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87A as +12 VDC is applied and removed from terminal 85.

5. Disconnect voltage and multimeter leads from the relay terminals. Reconnect relay to vehicle wire harness.

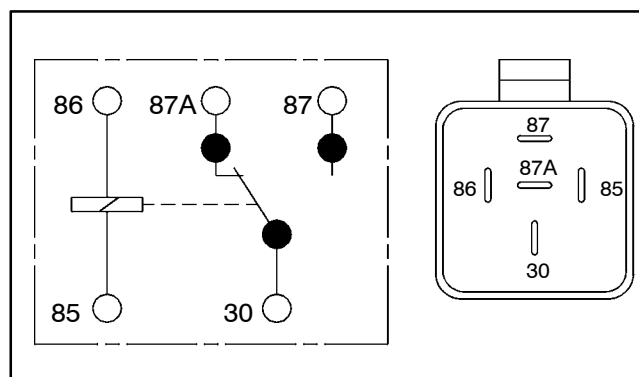


Figure 13

Battery

Use a digital multi meter to measure the voltage between the battery terminals.

If the voltage is less than 12.3 Volts DC, the battery should be charged.

NOTE: Regulated battery voltage will increase to approximately 13.5 Volts when the engine is running.

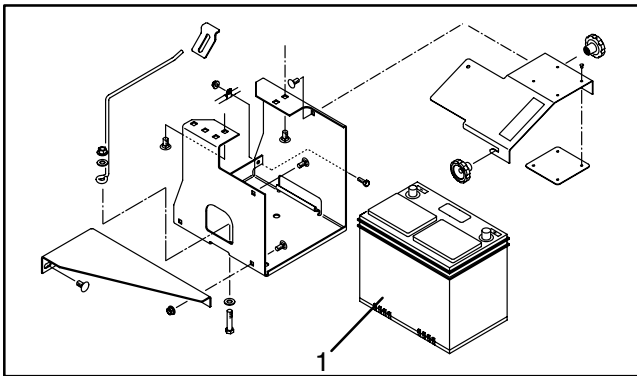


Figure 13

1. Battery

Indicator Lights and Gauges

Oil Pressure Light

The oil pressure lamp should come on when the ignition key switch is in the “RUN” position with the engine not running or if the oil pressure switch closes during operation – oil pressure below 7 psi (0.5 kg/cm²). Test the lamp by disconnecting the wires and applying 12 VDC. between the lamp wiring terminals.

Charging Light (Liquid Cooled Engines)

The charging light should come on when the ignition key switch is in the “RUN” position with the engine not running or if the charging circuit is not operating properly during operation. Test the lamp by disconnecting the wires and applying 12 VDC. between the lamp wiring terminals.

Glow Light (Diesel Engine)

The glow light should be on when the ignition key switch is in the “RUN” position and the glow switch is “ON”. Test the lamp by disconnecting the wires and applying 12 VDC. between the lamp wiring terminals.

Hourmeter

Test the hourmeter by connecting a 12 volt battery so the positive (+) battery terminal is connected to the positive terminal on the hourmeter. Connect the negative (–) battery terminal to the negative (–) terminal on the hourmeter. The hour meter should move 1/10 of an hour in six minutes as 12 VDC. is applied between the terminals.

Temperature Gauge and Fuel Level Gauge

To test a gauge, use a commercial gauge tester. If a commercial gauge tester is not available, substitute a new gauge or test the sending unit.

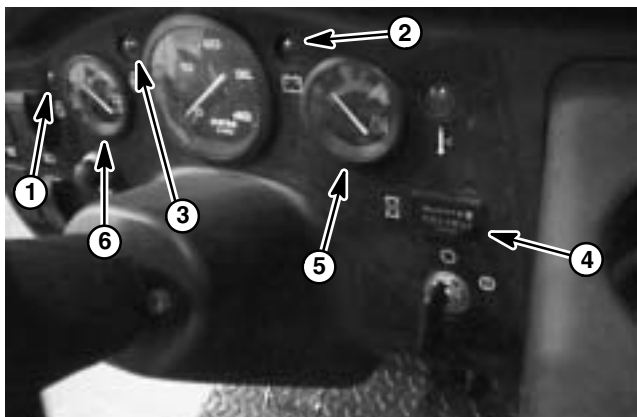


Figure 14

- | | |
|-----------------------|----------------------|
| 1. Oil pressure light | 4. Hourmeter |
| 2. Charging light | 5. Temperature gauge |
| 3. Glow light | 6. Fuel level gauge |

High Temperature Shutdown Switch (Briggs/Daihatsu Gas and Diesel Engine)

The high temperature shutdown switch is threaded into the thermostat housing (Fig. 15). There is a blue wire attached to the switch.

Testing



CAUTION

Make sure engine is cool before removing the temperature switch.

1. Lower coolant level in the engine and remove the temperature shutdown switch.
2. Put switch in a container of oil with a thermometer and slowly heat the oil (Fig. 16).



CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

3. Check continuity of the switch with a multimeter (ohms setting). The temperature switch is normally open and should close at approximately 238°F (114°C).
4. Allow oil to cool while observing temperature. The temperature switch should open at about 232°F (111°C).
5. Replace switch if necessary.
6. Install switch to the water pump.
 - A. Clean threads of water pump housing and switch thoroughly. Apply thread sealant to the threads of the switch.
 - B. Screw switch into the water pump housing and tighten.
 - C. Connect blue wire to switch.
7. Fill engine cooling system (see Operator's Manual).

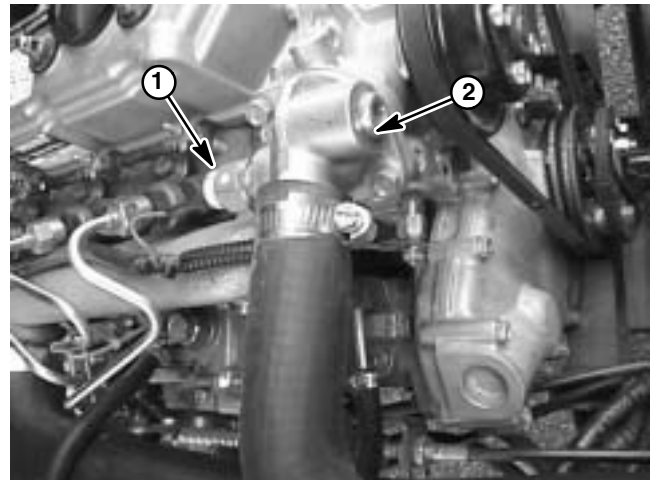


Figure 15

1. Temp. shutdown switch 2. Thermostat housing

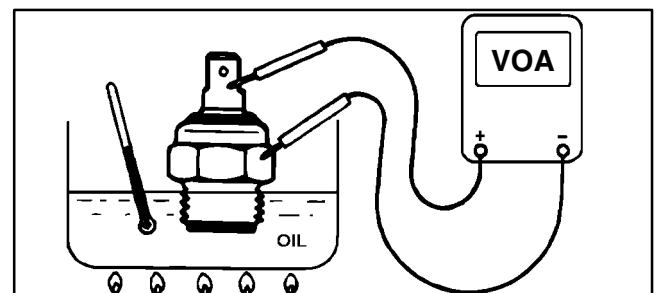


Figure 16

Fuel Gauge Sender

Disconnect wire and remove the fuel gauge sender from the fuel tank.



CAUTION

Make sure sending unit is completely dry (no fuel on it) before testing. Perform test away from the tank to prevent an explosion or fire from sparks.

Install an ohm meter between the terminal and base.

With arm completely down (empty position), resistance should be 240–260 ohms.

With arm completely up (full position), resistance should be 29–34 ohms.

NOTE: If necessary, bend float arm to get proper gauge reading for a 1/2 full tank (approximately 110 ohms).

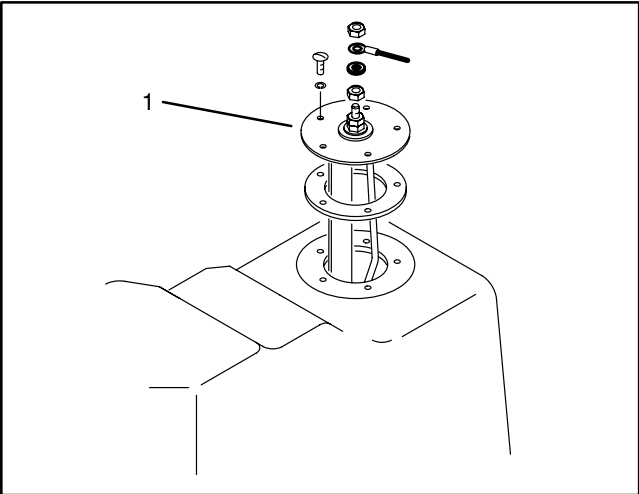


Figure 17

1. Fuel gauge sender

Headlight Switch

The headlight switch is located on the control panel. This rocker switch allows the headlights to be turned on and off.

The switch terminals are marked as shown in Figure 19. The circuitry of the headlight switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
ON	2 + 3	5 + 6
OFF	1 + 2	4 + 5



Figure 18

1. Headlight switch

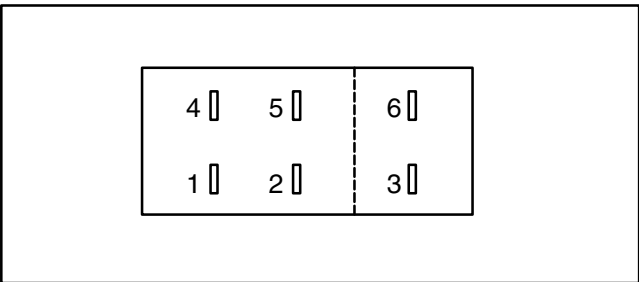


Figure 19

Glow Plug Switch (Briggs/Daihatsu Diesel Engine)

The glow plug switch is located on the control panel on vehicles powered with a diesel engine. This rocker switch allows the glow plugs to be energized.

The switch terminals are marked as shown in Figure 20. The circuitry of the glow plug switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

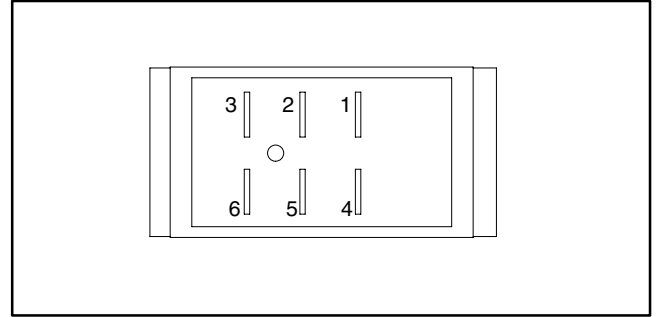


Figure 20

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	2 + 3	5 + 6
MOMENTARY ON	1 + 2	4 + 5

Diodes (Briggs/Daihatsu Gas and Diesel Engine)

Diodes D1 and D2 are used for circuit protection from voltage spikes that occur when a solenoid is de-energized. Diode D1 is in the optional hydraulic circuit and D2 is in the starting circuit.

These diodes plug into the vehicle wiring harness at various locations (see appropriate vehicle electrical schematic in Chapter 11 – Electrical Schematics).

Testing

The diodes can be individually tested using a digital multimeter (diode test or ohms setting) and the table to the right.

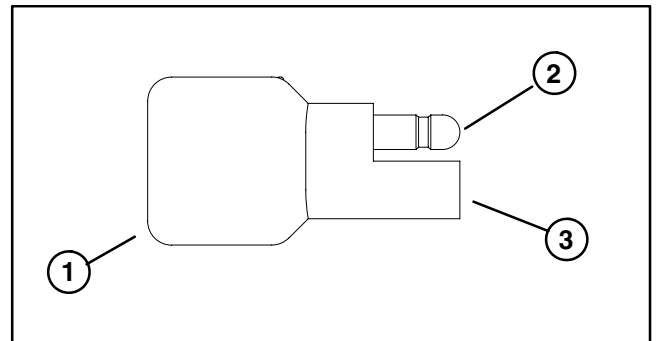


Figure 21

- 1. Diode
- 2. Male terminal
- 3. Female terminal

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (-) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

Diode Assembly (Kohler Engine)

The diode assembly on Kohler powered Workman vehicles is used for circuit protection from voltage spikes that occur when the starter solenoid is de-energized.

The diode assembly plugs into the vehicle wiring harness (see Workman 3100 electrical schematic in Chapter 11 – Electrical Schematics).

Testing

The diode assembly can be tested using a digital multimeter (diode test or ohms setting) and the table to the right.

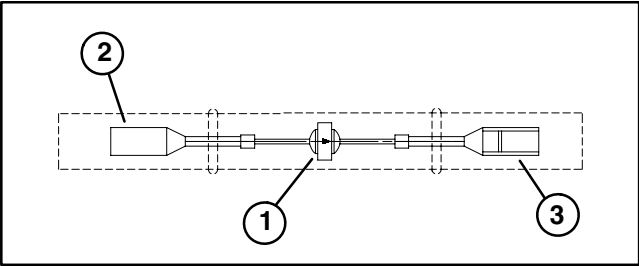


Figure 22

1. Diode
2. Male terminal
3. Female terminal

Multimeter Red Lead (+) on Terminal Blade	Multimeter Black Lead (-) on Terminal Blade	Continuity
Male	Female	YES
Female	Male	NO

Rear PTO Switch (Optional)

On vehicles equipped with the optional rear PTO kit, the rear PTO switch is located in the rear PTO housing mounted on the top of the transaxle. The Rear PTO switch is normally closed and opens when the PTO is engaged.

Test the switch by disconnecting the wiring connector and connecting a continuity tester across the two terminals. With the engine off, move PTO lever to OFF position – there should be an indication of continuity. Move PTO lever to ON – there should be no continuity.

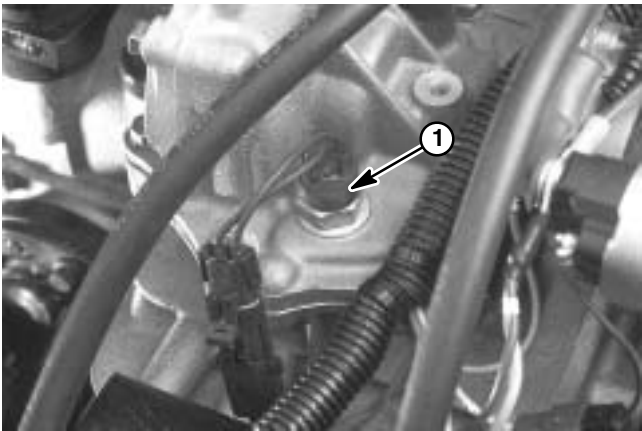


Figure 23

1. Rear PTO switch

Service and Repairs

Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.



CAUTION

When working with batteries, use extreme caution to avoid slashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Battery Specifications (Liquid Cooled Engines)

BCI Group 34 Battery:
690 Amp Cold Cranking Performance at 0° F (–18° C)
100 minute Reserve Capacity at 80° F (27° C)

Battery Specifications (Air Cooled Engines)

BCI Group 26 Battery:
525 Amp Cranking Performance at 0° F (–18° C)
80 min. Reserve Capacity at 80° F (27° C)

Electrolyte Specific Gravity

Fully charged: 1.250 – 1.280
Discharged: less than 1.240

Removal (Fig. 24)

IMPORTANT: Be careful not to damage terminal posts or cable connectors when removing the battery cables.

1. Remove battery cover from the frame. Loosen battery retainer securing the back of the battery to the battery support.
2. Loosen nut on ground cable (–) post first and remove cable from battery. This should prevent short circuiting the battery, other components, or the operators hands.
3. Loosen nut on positive (+) cable post and remove cable from battery.
4. Remove battery from the battery compartment to a service area to allow better access for service.

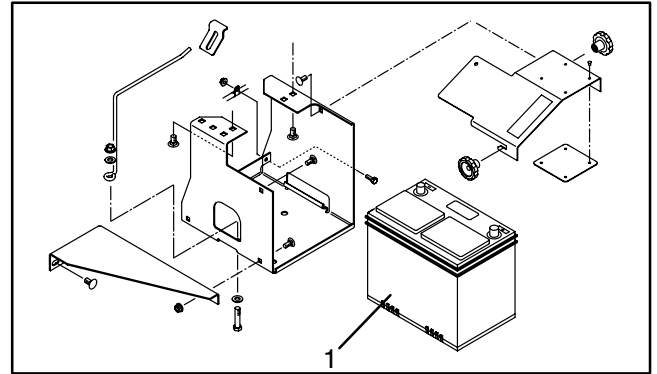


Figure 24

1. Battery

Inspection, Maintenance, and Testing

1. Perform following inspections and maintenance:
 - A. Check for cracks. Replace battery if cracked or leaking.
 - B. Check battery terminal posts for corrosion. Use wire brush to clean corrosion from posts.
- IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.**
- C. Check for signs of wetness or leakage on the top of the battery which might indicate a loose filler cap, overcharging, loose terminal post, or overfilling. Also, check battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.
 - D. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.
 - E. If battery filler caps are removable, check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water so that plates are just covered with electrolyte. Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.

2. If battery filler caps are removable, conduct a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm-up the hydrometer. At the same time take the temperature of the cell.

B. Temperature correct each cell reading. For each 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature 100°F
Cell Gravity 1.245
100°F minus 80°F equals 20°F
(37.7°C minus 26.7°C equals 11.0°C)
20°F multiply by 0.004/10°F equals 0.008
(11°C multiply by 0.004/5.5°C equals 0.008)
ADD (conversion above) 0.008
Correction to 80°F (26.7°C) 1.253

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

3. Perform a high-discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is **required** to perform this test.

**CAUTION**

Follow the manufacturer's instructions when using a battery tester.

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.4 VDC, recharge the battery.

B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester **following the manufacturer's instructions**.

C. Make sure battery terminals are free of corrosion.

D. If battery filler caps are removable, measure the temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of one half the Cranking Performance (see Battery Specifications) rating of the battery for 15 seconds.

G. Take a voltage reading at 15 seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading.

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70°F (and up)	21.1°C (and up)
9.5	60°F	15.6°C
9.4	50°F	10.0°C
9.3	40°F	4.4°C
9.1	30°F	-1.1°C
8.9	20°F	-6.7°C
8.7	10°F	-12.2°C
8.5	0°F	-17.8°C

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Installation (Fig. 24)

IMPORTANT: To prevent possible electrical problems, install only a fully charged battery.

1. Make sure ignition and all accessories are **off**.
2. Make sure battery compartment is clean and repainted if necessary.
3. Make sure all battery cables and connections are in good condition and battery retainer has been repaired or replaced.
4. Place battery in its compartment. Make sure battery is level and flat. Connect positive cable connector onto positive battery post. Tighten cap screw and nut with two wrenches.
5. Secure battery retainer. Do not overtighten retainer to prevent cracking or distorting the battery case.

6. Apply a light coat of grease on all battery posts and cable connectors to reduce corrosion after connections are made.

7. Connect a digital multimeter (set to amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the unit's electrical system should be tested and repaired.

8. Connect negative (ground) cable connector to the negative battery post. Tighten cap screw and nut with two wrenches.

Charging

To minimize possible damage to the battery and to allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is available in most shops.



CAUTION

Follow the manufacturer's instructions when using a battery charger.

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.


1. If battery filler caps are removable, check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water so that plates are just covered with electrolyte.

2. Determine the battery charge level from either its open circuit voltage or specific gravity (if filler caps are removable).

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

3. Determine the charging time and rate **using the manufacturer's battery charger instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps



CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15.5°C) before connecting to a charger.

Charge the battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

4. **Following the manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

5. Charge the battery **following the manufacturer's instructions**.

6. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125°F (51.6°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

7. Three hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three consecutive readings.

8. If battery filler caps are removable, check the electrolyte level in each cell. Adjust electrolyte level if needed.

Headlight Replacement

Disassemble and assemble headlight as follows:

1. Set parking brake, turn ignition off, and remove key.
2. Reach beneath dash and disconnect the wiring harness connector from the headlight.
3. From beneath the dash, push headlight out of the hood.
4. Remove rubber seal from around the headlight. Discard headlight.
5. Align notch on the inside of the seal with the notch on the new headlight. Slide seal onto the headlight until the seal is firmly in place.

NOTE: Applying soapy water to the outside of the seal will aid in sliding the seal into the hood. Make sure to thoroughly dry headlights before turning lights on.

6. Align notch on the outside of the seal with the notch in the hood. Push headlight and seal into the hood until it is firmly in place.

7. Connect the wiring harness connector to the headlight.

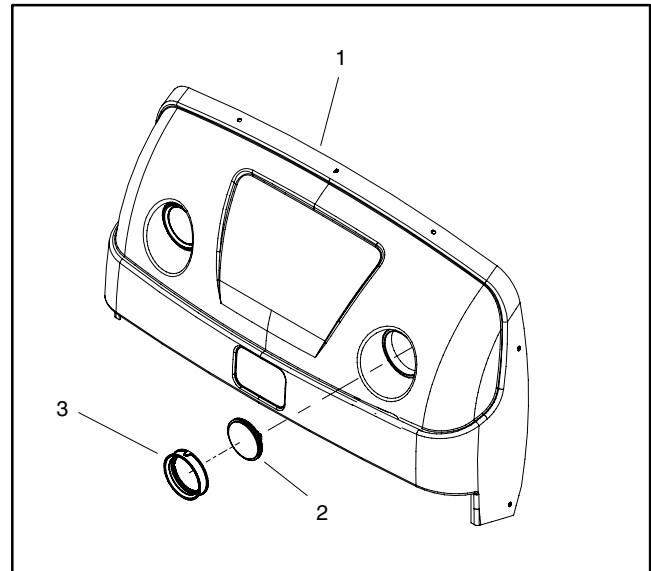


Figure 25

- | | |
|---------------|--------------------|
| 1. Front hood | 3. Headlight mount |
| 2. Headlight | |

Tail Lamp Replacement

Disassemble and assemble tail lamp using Fig. 26 as a guide.

The tail lamp uses a standard #1157 12volt bulb.

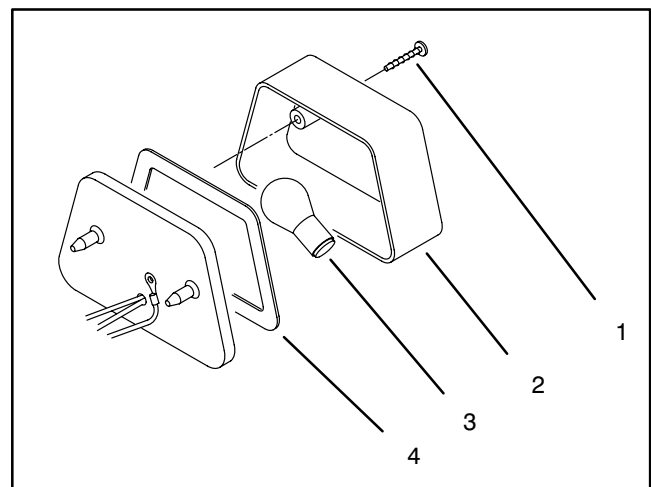


Figure 26

- | | |
|-------------------|-----------|
| 1. Screw (2 used) | 3. Bulb |
| 2. Lens | 4. Gasket |



Hydraulic System

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Specifications

Item	Description
Hydraulic Pump	Positive Displacement Gear Pump
Pump Performance	4 GPM (15 LPM) at 1,500 PSI (103.4 Bar)
System Relief Pressure	1,800 PSI (124.1 Bar)
Lift Control Valve	Three position control valve Spring return to neutral Ball checks to maintain load
Hydraulic Oil	Dexron III ATF
Reservoir (Transaxle)	8 U.S. quart (7.5 Liter) system capacity
Hydraulic Filter	Automotive, 10 micron spin-on cartridge type 25 PSI by-pass valve 100 mesh strainer in reservoir
Optional High Flow Hydraulic Kit Pump	Positive Displacement Gear Pump
Optional High Flow Hydraulic Kit Pump Performance	7.9 GPM (30 LPM) at 1,500 PSI (103.4 Bar)
Optional High Flow Hydraulic Kit System Relief Pressure	2,000 PSI (137.9 Bar)
Optional High Flow Hydraulic Kit Hydraulic Oil	Multigrade Hydraulic Fluid – ISO VG 46
Optional High Flow Hydraulic Kit Reservoir	4.5 U.S. gallon (17 Liter) capacity
Optional High Flow Hydraulic Kit Hydraulic Filter	Automotive, 10 micron spin-on cartridge type 25 PSI by-pass valve 100 mesh strainer in reservoir

NOTE: Vehicles that are equipped with the optional High Flow Hydraulic Kit have two independent hydraulic systems. Each of these hydraulic systems include a belt driven hydraulic gear pump, reservoir, filter and controls. Maintenance, troubleshooting and repair of each hydraulic system need to be performed independently.

General Information

Hydraulic Hoses

Hydraulic hoses are subject to extreme conditions such as pressure differentials during operation and exposure to weather, sun, chemicals, very warm storage conditions, or mishandling during operation or maintenance. These conditions can cause damage or premature deterioration. Some hoses are more susceptible to these conditions than others. Inspect the hoses frequently for signs of deterioration or damage.

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint on the hose. Use two wrenches; hold the hose straight with one and tighten the hose swivel nut onto the fitting with the other.



WARNING

Before disconnecting or performing any work on hydraulic system, relieve all pressure in system. Stop engine; lower or support box and/or other attachment(s).

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

Hydraulic Fitting Installation

O-Ring Face Seal

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.
2. Make sure the O-ring is installed and properly seated in the groove. It is recommended that the O-ring be replaced any time the connection is opened.
3. Lubricate the O-ring with a light coating of oil.
4. Put the tube and nut squarely into position on the face seal end of the fitting and tighten the nut until finger tight.
5. Mark the nut and fitting body. Hold the body with a wrench. Use another wrench to tighten the nut to the correct Flats From Finger Tight (F.F.T.). The markings on the nut and fitting body will verify that the connection has been tightened.

Size

4 (1/4 in. nominal hose or tubing)
6 (3/8 in.)
8 (1/2 in.)
10 (5/8 in.)
12 (3/4 in.)
16 (1 in.)

F.F.T.

0.75 ± 0.25
 0.75 ± 0.25
 0.75 ± 0.25
 1.00 ± 0.25
 0.75 ± 0.25
 0.75 ± 0.25

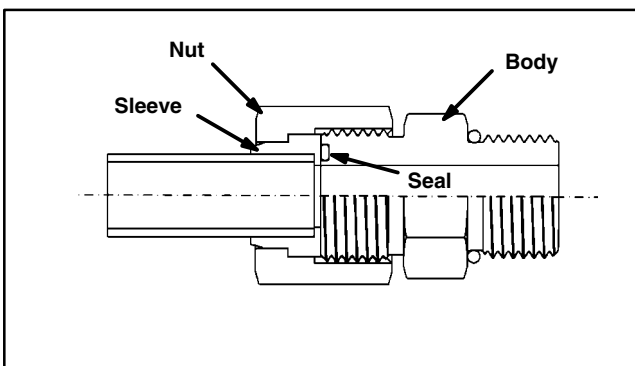


Figure 1

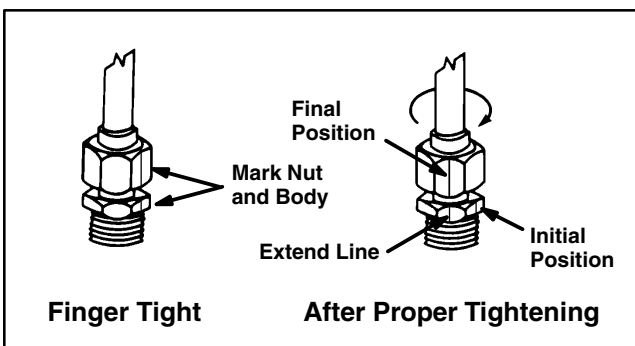


Figure 2

SAE Straight Thread O-Ring Port – Non-adjustable

- 1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.
- 2. Always replace the O-ring seal when this type of fitting shows signs of leakage.
- 3. Lubricate the O-ring with a light coating of oil.
- 4. Install the fitting into the port and tighten it down full length until finger tight.
- 5. Tighten the fitting to the correct Flats From Finger Tight (F.F.F.T.).

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

NOTE: Installation torque values for non-adjustable fittings are listed in Figure 4. These torque values should **only** be used when a fitting can be accessed with a socket. Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench accuracy and should not be used.

SAE Straight Thread O-Ring Port – Adjustable

- 1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.
- 2. Always replace the O-ring seal when this type of fitting shows signs of leakage.
- 3. Lubricate the O-ring with a light coating of oil.
- 4. Turn back the jam nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1).
- 5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2).
- 6. To put the fitting in the desired position, unscrew it by the required amount, but no more than one full turn (Step 3).
- 7. Hold the fitting in the desired position with a wrench and turn the jam nut with another wrench to the correct Flats From Finger Tight (F.F.F.T.) (Step 4).

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

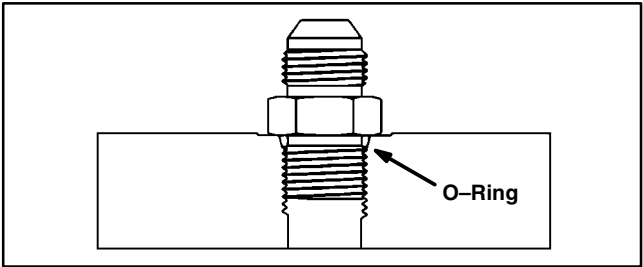


Figure 3

Fitting Size	Installation Torque
4	9–10 ft-lb (12–13 N-m)
6	20–21 ft-lb (27–28 N-m)
8	35–37 ft-lb (47–50 N-m)
10	60–66 ft-lb (81–89 N-m)
12	81–87 ft-lb (110–117 N-m)
16	121–131 ft-lb (164–177 N-m)

Figure 4

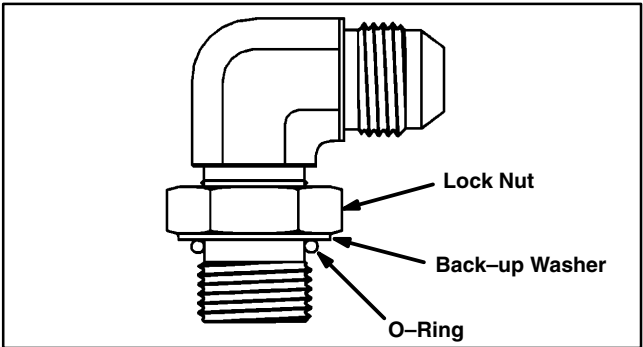


Figure 5

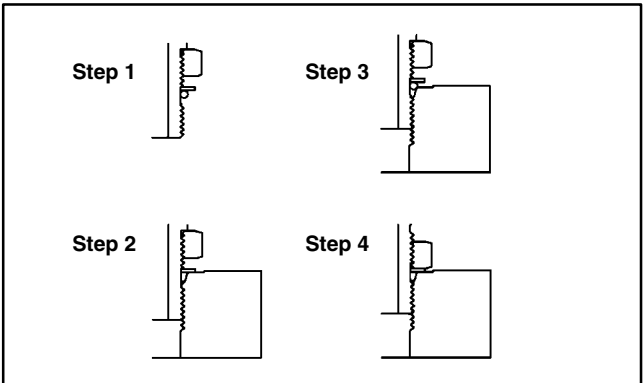
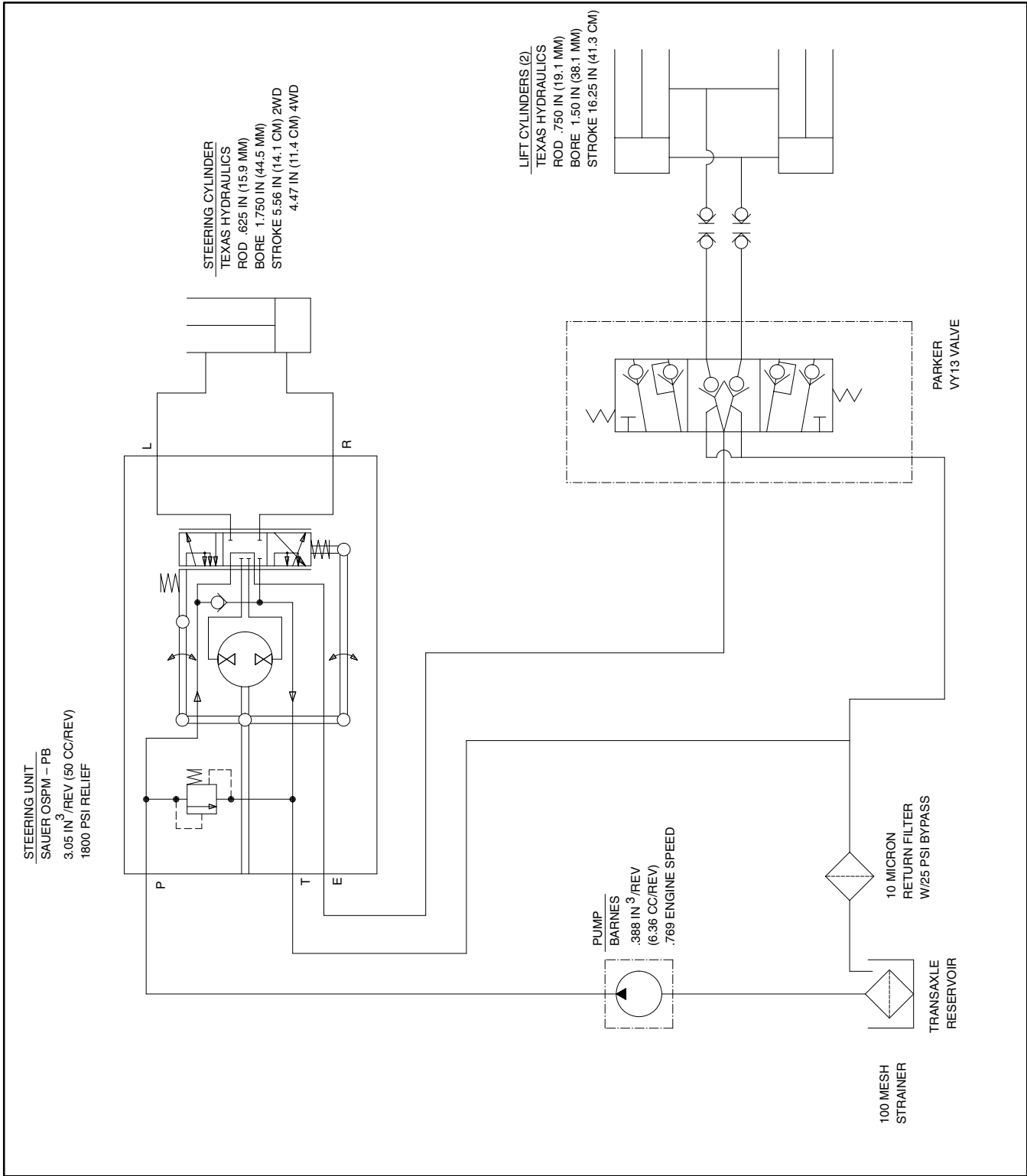


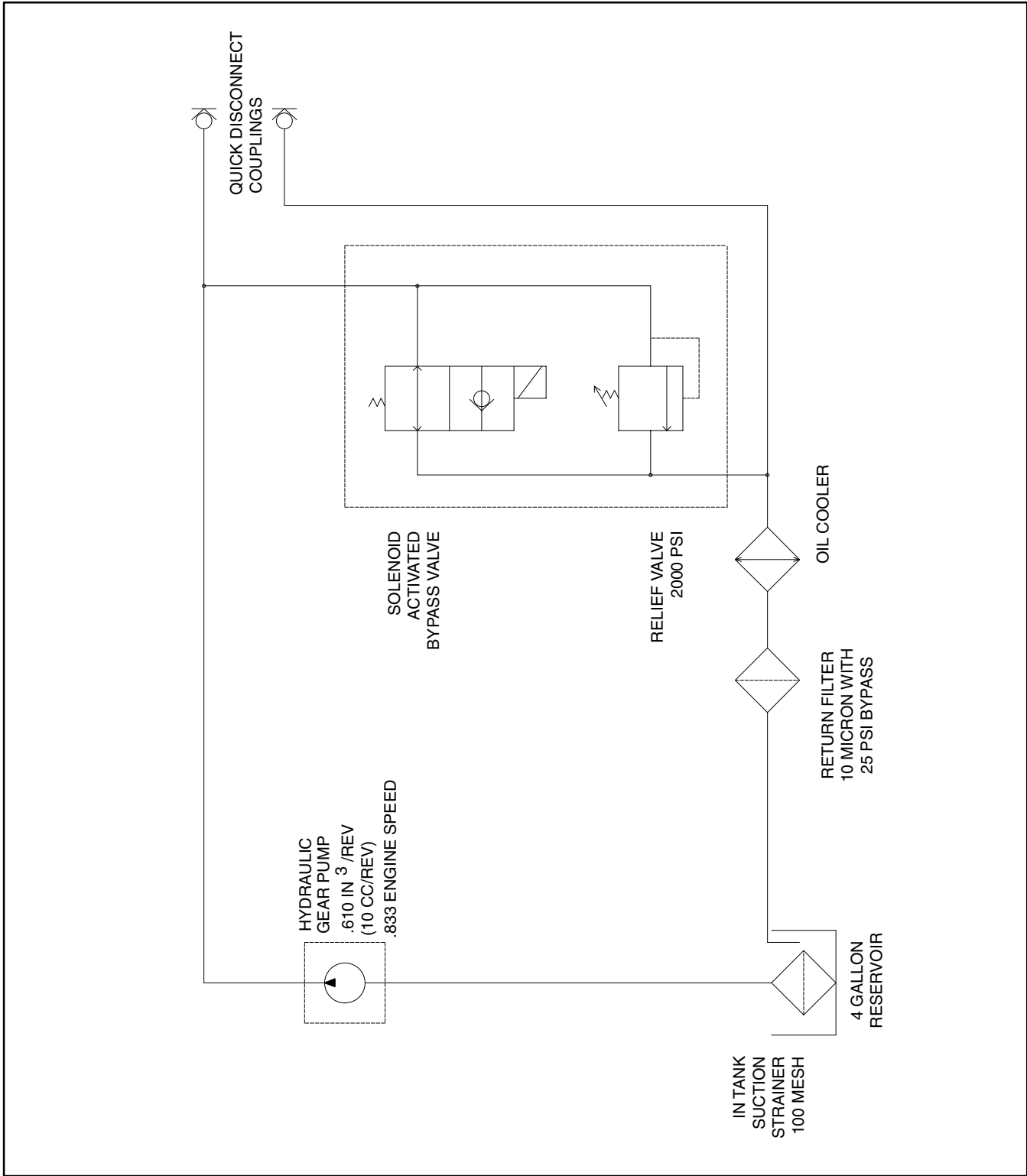
Figure 6

Hydraulic Schematics

Vehicle Hydraulic Schematic



High Flow Hydraulic Kit (Optional) Schematic



Hydraulic Circuit Operation

Steering Circuit

The hydraulic gear pump supplies flow for the steering circuit and for raising and lowering the bed. Pump output flows to the steering control valve before reaching the lift valve so the steering circuit has priority. Circuit pressure is limited by a relief valve located in the steering control valve.

When the steering wheel is not being turned with the engine running (hydraulic pump being rotated), flow enters the steering control valve at the P port and by-passes the rotary meter and steering cylinder. Flow leaves the control valve through the E port and is directed to the lift valve.

Left Turn

When a left turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the top of the spool. Flow entering the steering control valve at the P port passes through the rotary meter and is directed out the L port. Pressure contracts the steering cylinder for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel.

Fluid leaving the steering cylinder flows back through the spool valve, then out the T port and returns to the hydraulic reservoir (transaxle).

The steering wheel and steering control valve return to the neutral position when turning is completed.

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the bottom of the spool. Flow entering the steering control valve at the P port passes through the rotary meter and is directed out port R. Pressure extends the steering cylinder for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve, then out the T port and to the hydraulic reservoir (transaxle).

The steering wheel and steering control valve return to the neutral position when turning is completed.

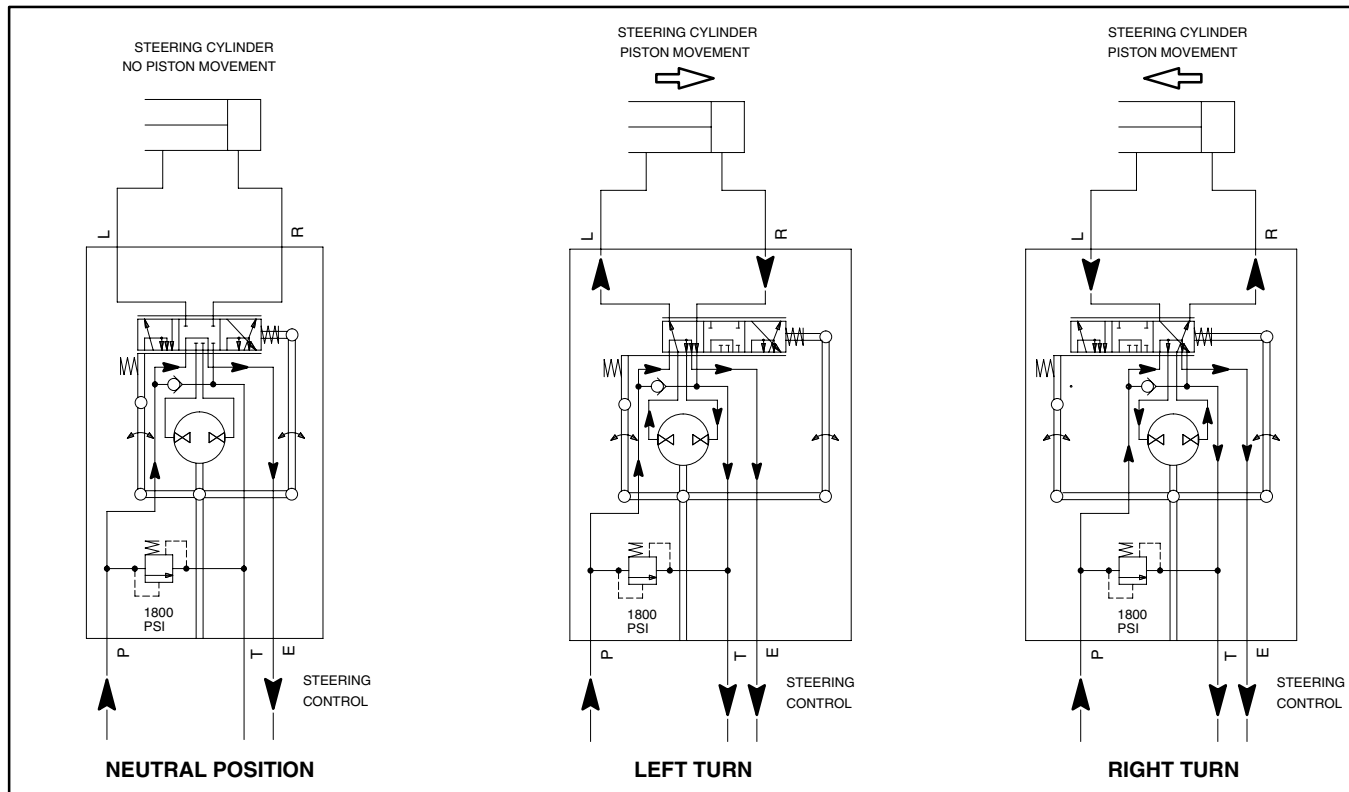


Figure 7

Raise and Lower Bed

The hydraulic gear pump supplies flow for the steering circuit and for raising and lowering the bed. Pump output flows through the steering control valve and then to the lift valve for raising and lowering the bed (flow priority to the steering circuit). Circuit pressure is limited by a relief valve located in the steering control valve.

When the lift valve is in the center position, flow from the gear pump by-passes the lift valve and returns through the hydraulic oil filter and to the reservoir (transaxle).

Raise Bed

When the bed is to be raised (lift lever pulled rearward), the lift valve spool directs flow out the A port of the lift valve to the barrel end of the lift cylinders. Hydraulic pressure against the cylinder pistons extends the cylinder shafts. At the same time, the pistons push the hydraulic fluid in the rod end of the lift cylinders out and through the lift valve to the reservoir (transaxle).

When the control valve lever is released, spring action returns the lift valve spool to the center position and lift cylinder movement is stopped. The cylinder position is locked in place since there is no complete circuit of flow to and from the lift cylinders.

Lower Bed

Circuit operation for lowering the bed (lift lever pushed forward) is similar to raising the bed. However, the lift valve spool directs flow from the B port of the lift valve to the rod end of the lift cylinders. Hydraulic pressure against the cylinder pistons retracts the cylinder shafts to lower the bed.

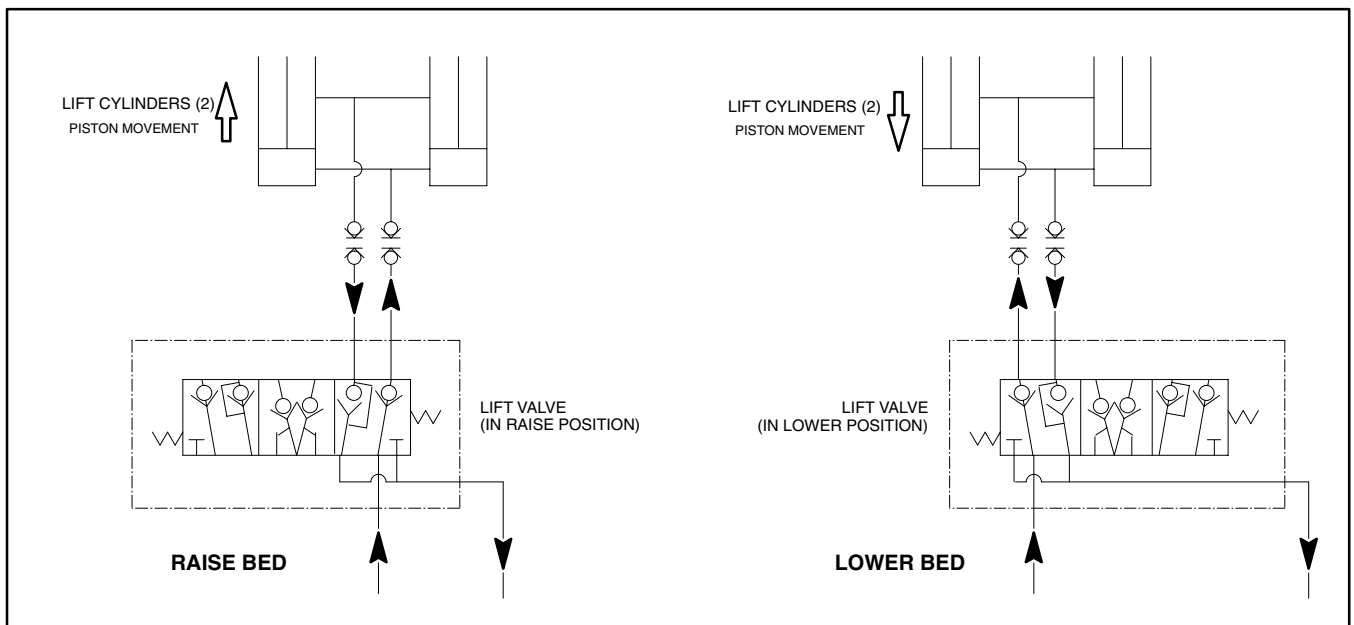


Figure 8

Special Tools

Order these tools from your Toro Distributor.

Hydraulic Pressure Test Kit (TOR47009)

Use to take various pressure readings for diagnostic tests. Quick disconnect fittings provided attach directly to mating fittings on vehicle test ports without tools. A high pressure hose is provided for remote readings. Contains one each: 1000 PSI (70 Bar), 5000 PSI (350 Bar) and 10000 PSI (700 Bar) gauges. Use gauges as recommended in Testing section of this chapter.



Figure 9

Hydraulic Tester (Pressure and Flow) (TOR214678)

Use to test hydraulic circuits and components for flow and pressure capacities as recommended in the Testing section of this chapter. This tester includes the following:

1. **INLET HOSE:** Hose connected from the system circuit to the inlet side of the hydraulic tester.
2. **LOAD VALVE:** A simulated working load is created in the circuit by turning the valve to restrict flow.
3. **PRESSURE GAUGE:** Glycerine filled 0 to 5000 PSI gauge to provide operating circuit pressure.
4. **FLOW METER:** This meter measures actual oil flow in the operating circuit with a gauge rated from 1 to 15 GPM (5 to 55 LPM).
5. **OUTLET HOSE:** A hose from the outlet side of the hydraulic tester connects to the hydraulic system circuit.
6. **FITTINGS:** An assortment of hydraulic fittings are included with this kit.



Figure 10

Hydraulic Test Fitting Kit (TOR4079)

This kit includes a variety of O-ring Face seal fittings to enable connection of test gauges to the hydraulic system.

The kit includes: tee's, unions, reducers, plugs, caps and male test fittings.









TORO TEST FITTING KIT (NO. TOR4079)			
FITTING	TOOL NUMBER	FITTING	TOOL NUMBER
	Tee (3 ea.) Size Tool No. No. 4 TOR4079-1 No. 6 TOR4079-12 No. 8 TOR4079-14 No. 10 TOR4079-16		Union (1 ea.) Size Tool No. No. 4 to No. 8 TOR4079-3 No. 10 to No. 8 TOR4079-4 No. 8 to No. 6 TOR4079-5
	Plug (1 ea.) Size Tool No. No. 4 TOR4079-13 No. 6 TOR4079-15 No. 8 TOR4079-17 No. 10 TOR4079-19		Reducer (1 ea.) Size Tool No. No. 10 to No. 8 TOR4079-7 No. 8 to No. 6 TOR4079-8
	Cap (2 ea.) Size Tool No. No. 4 TOR4079-11 No. 6 TOR4079-18 No. 8 TOR4079-20 No. 10 TOR4079-22		Test Cap Fitting (2 ea.) Size Tool No. No. 4 TOR4079-14 No. 6 TOR4079-16 No. 8 TOR4079-18 No. 10 TOR4079-20
	Male Fitting (2 ea.) Size Tool No. No. 4 to No. 8 TOR4079-23 No. 10 to No. 8 TOR4079-24		Male Fitting (2 ea.) Size Tool No. No. 4 to No. 8 TOR4079-23 No. 10 to No. 8 TOR4079-24

Figure 11

Male Coupler (For Optional High Flow Hydraulic Kit) (#105–4170)

Male coupler that fits into female hydraulic coupler that is included in High Flow Hydraulic Kit. Male coupler can be used when testing hydraulic components of High Flow Kit.

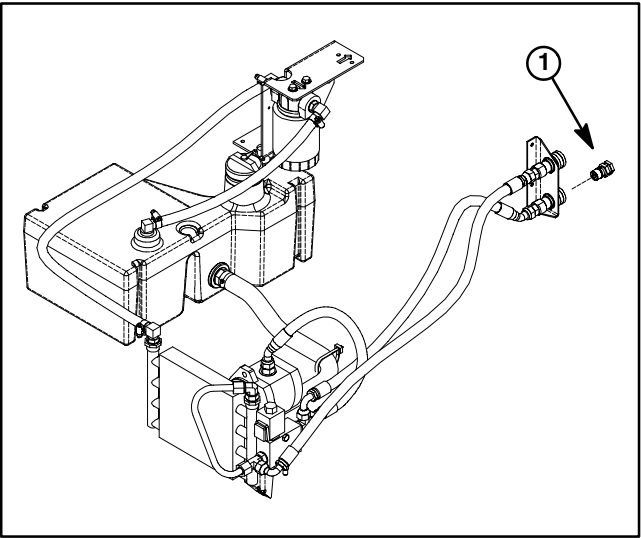


Figure 12

1. Male coupler

Troubleshooting

The cause of an improperly functioning hydraulic system is best diagnosed with the use of proper testing equipment and a thorough understanding of the complete hydraulic system.

A hydraulic system with an excessive increase in heat or noise is a potential failure. Should either of these conditions be noticed, immediately stop the vehicle, turn off the engine, locate the cause of the trouble and correct it before allowing the vehicle to be used again. Contin-

ued use of an improperly functioning hydraulic system could lead to extensive internal component damage.

The charts that follow contain information to assist in troubleshooting. There may possibly be more than one cause for a vehicle malfunction.

Refer to the Testing section of this Chapter for precautions and specific test procedures.

Problem	Possible Cause
Hydraulic oil leaks.	Fitting(s), hose(s), or tube(s) are loose or damaged. O-ring(s) or seal(s) are missing or damaged.
Squealing noise.	Hydraulic lift valve held in raise or lower position (hydraulic oil flowing over relief valve).
Hydraulic oil is overheating.	Oil level in transaxle is incorrect. Hydraulic oil is contaminated or incorrect oil (use Dexron III ATF). Kinked or severely bent hose or tubing. Hydraulic oil going over relief valve excessively (too heavy a load on hydraulic system or quick coupler disconnected with lift valve engaged). Suction screen in transaxle is loose or clogged. Worn or damaged hydraulic gear pump (Note: entire hydraulic system affected). Transaxle or drive train problem (see Drive Train – Chapter 7).
Bed does not lift or lifts too slowly.	Excessive load in bed. Oil level in transaxle is low. Engine RPM is low. Incorrect oil in system (use Dexron III ATF). Lift cylinder pivots or bed pivots are binding or damaged. Hydraulic pump drive belt loose. Lift cylinder(s) worn or damaged. Sheared key on gear pump shaft (Note: entire hydraulic system affected). Low gear pump flow or pressure (see TEST NO. 1) (Note: entire hydraulic system affected).

Problem	Possible Cause
Lift cylinders extend with valve in neutral position.	<p>Load checks in hydraulic lift valve are leaking.</p> <p>Lift valve lever is sticking.</p> <p>Lift valve control handle is not in correct location.</p> <p>Hydraulic relief valve stuck or damaged (see TEST NO. 1).</p>
Bed drops from raised position with lift valve in centered position.	<p>Improperly positioned valve.</p> <p>Lift valve worn or damaged.</p> <p>Internal leakage of lift cylinder(s).</p> <p>Lift cylinder hydraulic lines or fittings leaking.</p>
Steering inoperative or sluggish	<p>Engine speed is low.</p> <p>Oil level in transaxle is low.</p> <p>Steering components (Pitman arm, tie rods, steering cylinder rod ends) worn or binding.</p> <p>Gear pump drive belt is loose (Note: Loose belt will also cause the bed not to lift or other attachment to not operate).</p> <p>Steering cylinder is binding.</p> <p>Hydraulic relief valve stuck or damaged (see TEST NO. 1).</p> <p>Steering control valve is worn or damaged.</p> <p>Pulley key (either on drive or driven pulley) is sheared (lift circuit affected as well).</p> <p>Steering cylinder leaks internally.</p> <p>Low gear pump flow or pressure (see TEST NO. 1) (Note: Low pump flow or pressure will also cause the bed not to lift or other attachment to not operate).</p> <p>Gear pump is worn or damaged (Note: entire hydraulic system affected).</p>

Difficulty in connecting or disconnecting quick couplers.	<p>Pressure not relieved (coupler under pressure – engine running).</p> <p>Hydraulic lift valve not in neutral (centered) position.</p>
Attachment does not function.	<p>Quick couplers not fully engaged.</p> <p>Quick couplers are interchanged.</p> <p>Gear pump drive belt is loose (steering circuit affected as well).</p> <p>Sheared key on gear pump shaft.</p> <p>Oil level in transaxle is low.</p> <p>Engine RPM is low.</p> <p>Excessive load on attachment.</p> <p>Low gear pump flow or pressure (see TEST NO. 1).</p> <p>Hydraulic relief valve stuck or damaged (see TEST NO. 1).</p> <p>Hydraulic lift valve worn or damaged.</p> <p>Hydraulic component(s) on attachment malfunctioning or damaged.</p>

Testing

The most effective method for isolating problems in the hydraulic system is by using hydraulic test equipment such as pressure gauges and flow meters in the circuits during various operational checks. (See Special Tools section in this Chapter.)


**CAUTION**

Failure to use gauges with recommended pressure (psi) rating as listed in test procedures could result in damage to gauge and possible personal injury from leaking hot oil.

Before Performing Hydraulic Tests

All obvious areas such as oil supply, filter, binding linkage, loose fasteners, or improper adjustments must be checked before assuming that a hydraulic component is the source of the problem being experienced.

Precautions For Hydraulic Testing

**WARNING**

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved by stopping the engine, rotating the steering wheel in both directions, lowering or supporting the bed and operating other hydraulic accessories.

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

1. Thoroughly clean the vehicle before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Contamination will cause excessive wear of hydraulic components.

2. Put caps or plugs on any hydraulic lines left open or exposed during testing or removal of components.

3. The engine must be in good operating condition. Use a tachometer when making a hydraulic test. Engine speed will affect the accuracy of the tester readings.

4. Because the hydraulic pump is belt driven, check for proper pump belt adjustment before performing any hydraulic test.

5. To prevent damage to tester or components, the inlet and the outlet hoses must be properly connected, and not reversed (when using tester with pressure and flow capabilities).

6. To minimize the possibility of damaging components, completely open load valve in hydraulic tester (when using tester with pressure and flow capabilities).

7. Install fittings finger tight, far enough to insure that they are not cross-threaded, before tightening the fittings with a wrench.

8. Position the tester hoses so that rotating vehicle parts will not make contact with them and result in hose or tester damage.

9. Check and adjust the oil level in the transaxle after connecting hydraulic test equipment.

10. All hydraulic tests should be made with the hydraulic oil at normal operating temperature.

11. After testing is completed, check and adjust the oil level in the transaxle before returning the vehicle to service.

TEST NO. 1: Gear Pump Flow and System Relief Pressure

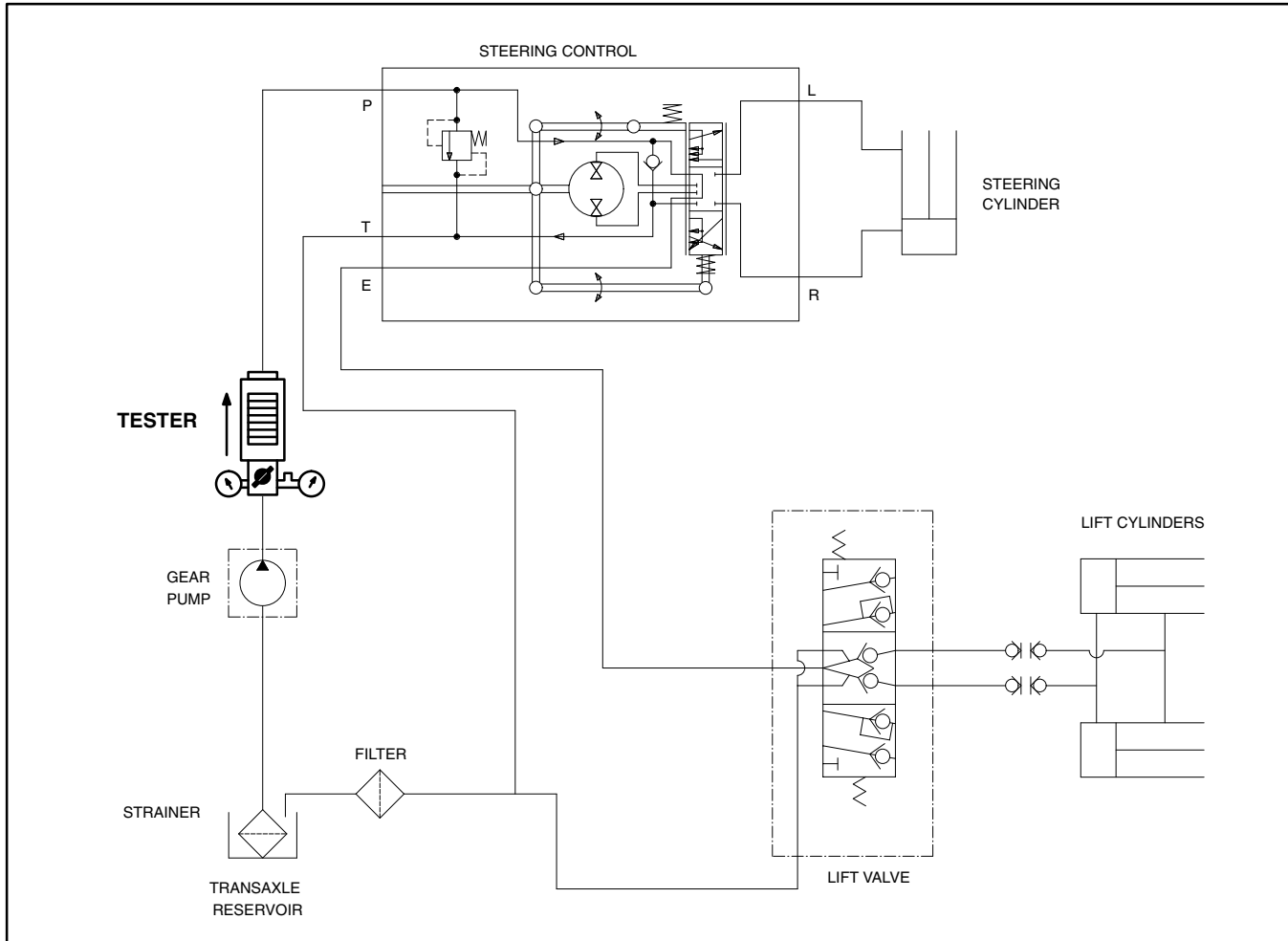


Figure 13

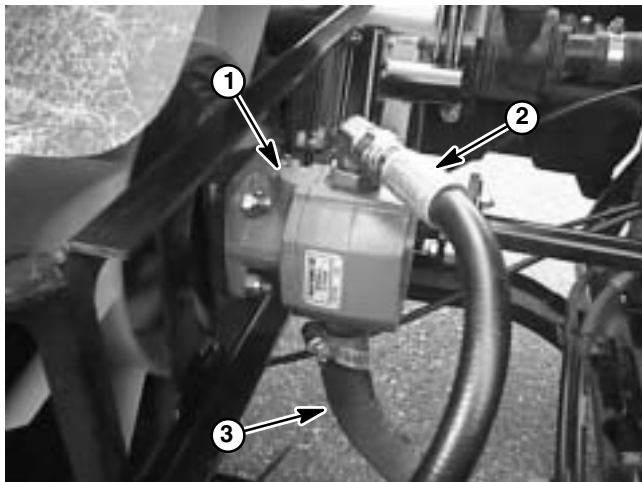


Figure 14

- 1. Gear pump
- 2. Pressure hose
- 3. Suction hose

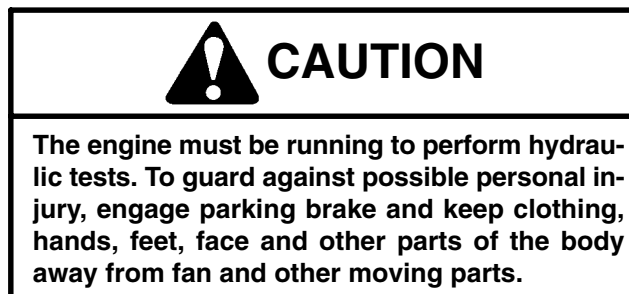
Procedure for Gear Pump Flow and System Relief Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the vehicle for approximately 10 minutes.
2. Park vehicle on a level surface, raise and support bed (if installed), shut engine off and engage the parking brake. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.
3. Make sure that gear pump drive belt is adjusted properly (see Operator's Manual).



IMPORTANT: Make sure that the oil flow indicator arrow on the flow meter is showing that the oil will flow from the pump, through the tester, and into the hydraulic hose.

4. With the engine off, clean hose fitting and disconnect the pressure hose from the gear pump (Fig. 14). Install tester with pressure gauges and flow meter in series between the gear pump and the disconnected hose. **Make sure the tester flow control valve is open.**
5. Make sure the hydraulic reservoir (transaxle) is full after connecting the tester.



6. After installing tester, start engine and run at idle speed. Check for hydraulic leakage and correct before proceeding with test.

IMPORTANT: In this test, the flow tester is positioned before the relief valve. Pump damage can occur if the oil flow is fully restricted.

7. Start engine and adjust engine speed with accelerator pedal so pump speed is **2700 RPM** (engine speed approximately 3600 RPM). Verify pump speed with a phototac.

8. While watching tester pressure gauges, slowly close flow control valve on the tester until **1500 PSI (103.4 Bar)** is obtained on gauge. Verify that pump speed continues to be correct (**2700 RPM**). Record flow meter reading.

GAUGE READING TO BE: Flow should be approximately **4.3 GPM (16.3 LPM)** at **1500 PSI (103.4 Bar)**.

9. Open tester flow control valve and stop engine.
10. If pump flow specification is not met, inspect for:
 - A. Slipping pump drive belt.
 - B. Worn or stuck relief valve.
 - C. Pump suction line restriction.
 - D. Gear pump needs to be repaired or replaced.
11. To test system relief pressure:
 - A. Make sure flow control valve on tester is fully open.
 - B. Start engine and depress accelerator pedal so engine is running at high idle (**3600 ± 50 RPM**).

IMPORTANT: Hold steering wheel at full lock only long enough to get a system pressure reading. Holding the steering wheel against the stop for an extended period can damage the steering control valve.

 - C. Watch pressure gauge carefully while turning the steering wheel completely in one direction (full steering lock) and holding momentarily.
 - D. System pressure should be approximately **1800 PSI (124.1 Bar)** as the relief valve lifts. Return steering wheel to the center position.
 - E. Release accelerator pedal to allow engine to return to low idle and turn off vehicle. Record test results.

12. If relief pressure is incorrect, inspect for:

- A. Slipping pump drive belt.
- B. Worn or stuck relief valve.

13. Remove tester and reinstall disconnected hose.

TEST NO. 2: Steering Control Valve and Steering Cylinder

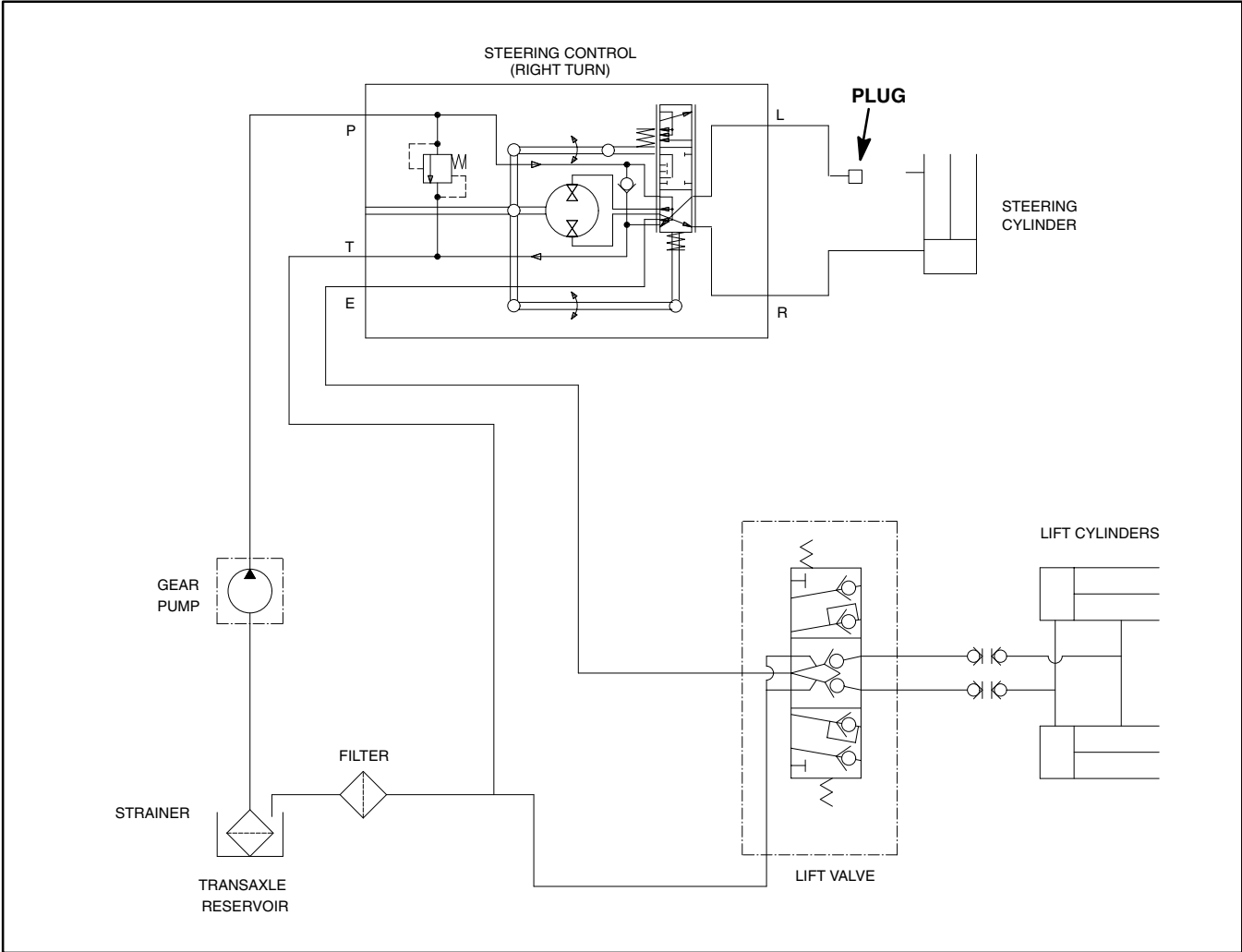


Figure 15

Procedure for Steering Control Valve and Steering Cylinder Test

1. Make sure hydraulic oil is at normal operating temperature by operating the vehicle for approximately 10 minutes.

NOTE: This steering test procedure will be affected by incorrect tire pressure, binding of the hydraulic steering cylinder, excessive weight on the vehicle, and/or binding of the steering assembly (e.g. wheel spindles, tie rods). Make sure that these items are checked before proceeding with any hydraulic testing procedure.

2. Perform the Gear Pump Flow and System Relief Pressure Tests (see Test No. 1) to make sure that gear pump and relief valve are functioning correctly.

3. Drive vehicle slowly in a figure eight on a flat level surface.

A. There should be no shaking or vibration in the steering wheel or front wheels.

B. Steering wheel movements should be followed **immediately** by a corresponding front wheel movement **without** the steering wheel continuing to turn.

4. Stop vehicle with the engine running. Turn steering wheel with small quick movements in both directions. Let go of the steering wheel after each movement. The steering wheel or front wheels should **not** continue to turn.

5. If either of these performance tests indicate a steering problem, determine if the steering cylinder is faulty using the following procedure.

A. Park vehicle on a level surface.

B. With the engine running, turn the steering wheel to the right (clockwise) until the steering cylinder rod is fully extended.

C. Turn engine off and engage the parking brake.

D. Read Precautions for Hydraulic Testing.

E. Clean and remove hydraulic hose from the fitting on the rod end of the steering cylinder. Plug the end of the disconnected hose (Fig. 15).



WARNING

Keep body and hands away from disconnected hoses and fittings that might eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

IMPORTANT: Do not turn steering wheel to the left (counterclockwise) as system damage may occur.

F. With the engine off, continue turning the steering wheel to the right (clockwise) with the steering cylinder fully extended. Observe the open fitting on the steering cylinder as the wheel is turned. If oil comes out of the fitting while turning the steering wheel to the right, the steering cylinder has internal leakage and must be repaired or replaced.

G. Remove plug from the disconnected hydraulic hose. Reconnect hose to the steering cylinder.

6. If steering problem exists and the steering cylinder, gear pump flow and system relief pressure (see Test No. 1) tested acceptably, steering control valve requires service (see Steering Control Valve and Steering Control Valve Service).

TEST NO. 3: Lift Cylinder Internal Leakage

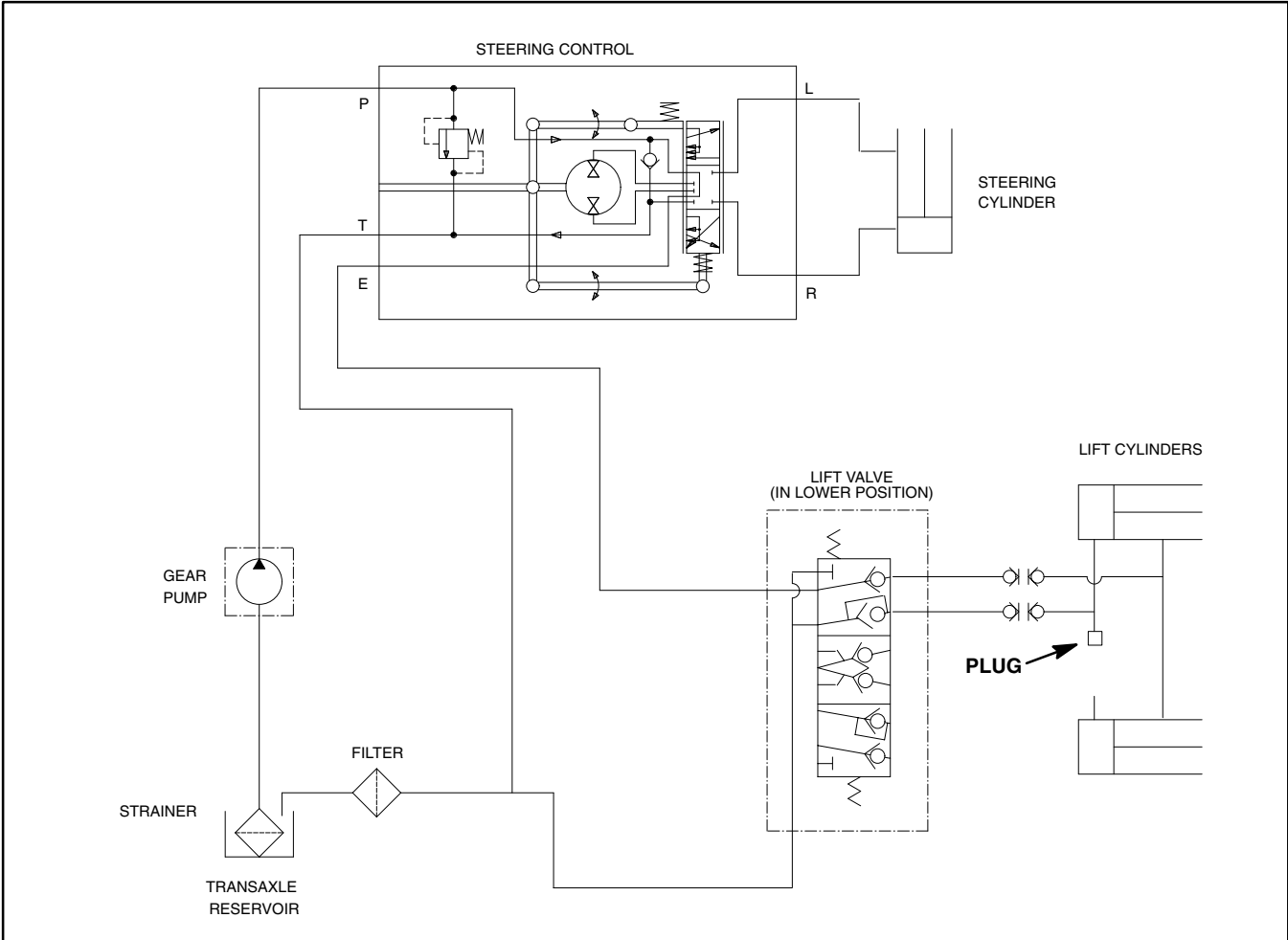


Figure 16

Procedure for Lift Cylinder Internal Leakage Test

1. Shut off engine and engage parking brake.

**CAUTION**

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS, and Precautions for Hydraulic Testing at the beginning of this section.

2. Remove all pressure from cylinder by fully retracting it (i.e. put hydraulic lift lever in LOWER position).
3. Disconnect hydraulic hose from base end of cylinder and install a steel plug with o-ring seal in the hose (Fig. 17). Clean any remaining oil from cylinder port.
4. Start engine and apply pressure to rod end of cylinder (i.e. put hydraulic lift lever in LOWER position).
5. If any oil comes out of open cylinder port, cylinder has an internal leak. Repair or replace cylinder.
6. Reconnect hose disconnected in step 3 after test or repairs are complete.

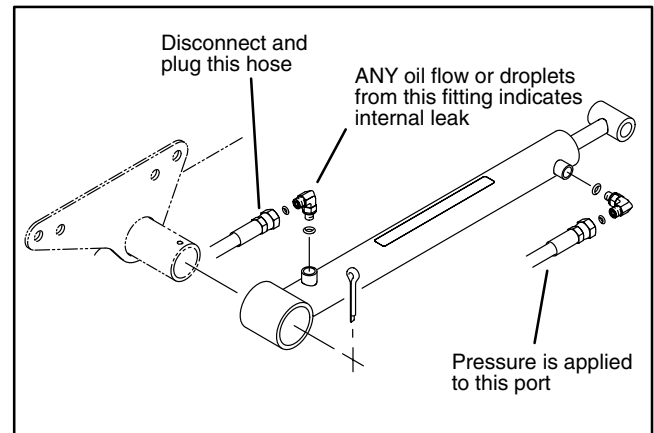


Figure 17

TEST NO. 4: High Flow Hydraulic Kit (Optional) Gear Pump Flow and Relief Pressure

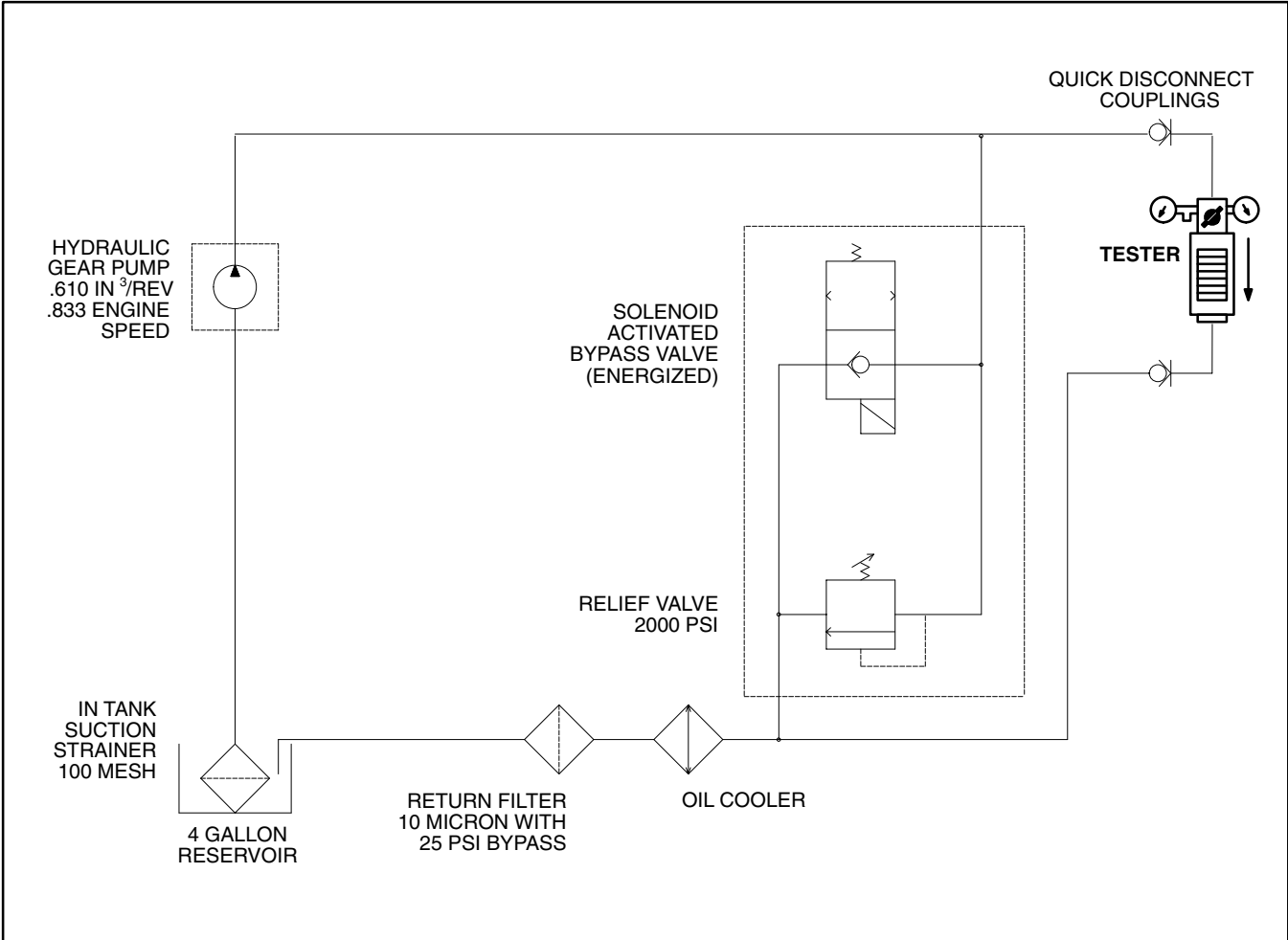


Figure 18

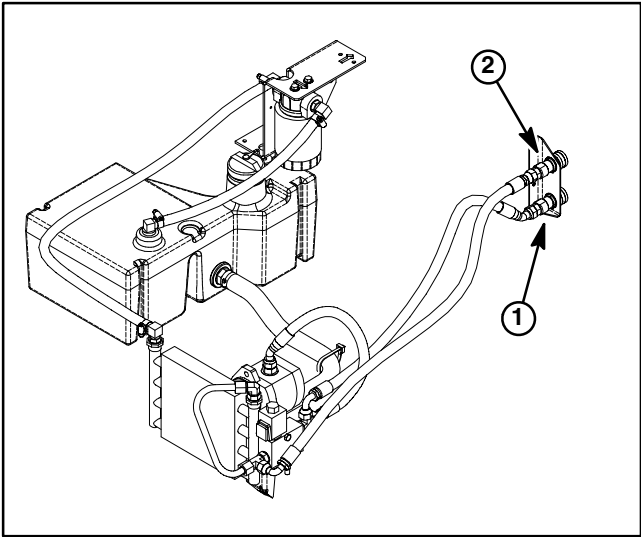


Figure 19

- 1. Pressure coupler
- 2. Return coupler

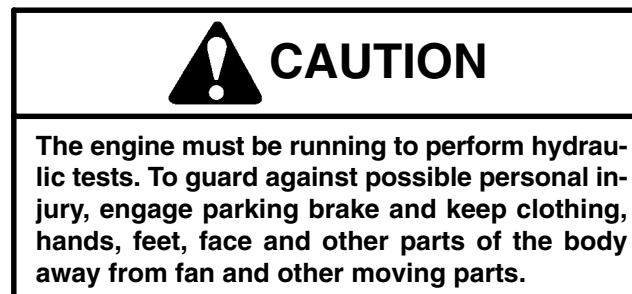
Procedure for High Flow Hydraulic Kit (Optional) Gear Pump Flow and System Relief Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the vehicle for approximately 10 minutes.
2. Park vehicle on a level surface, raise and support bed (if installed), shut engine off and engage the parking brake. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.
3. Make sure that drive belt for High Flow Kit gear pump is adjusted properly (see Kit Installation Instructions).



IMPORTANT: Make sure that the oil flow indicator arrow on the flow meter is showing that the oil will flow from the pressure coupler, through the tester, and into the return (tank) coupler (Fig. 19).

4. With the engine off, install tester with pressure gauges and flow meter in series between the quick disconnect couplings. **Make sure the tester flow control valve is open.**
5. Make sure the Hydraulic Kit reservoir is full after connecting the tester.



6. After installing tester, start engine and run at idle speed. Turn hydraulic kit switch ON and check for hydraulic leakage from connections. Correct before proceeding with test.
7. Adjust engine speed with accelerator pedal so High Flow Kit gear pump speed is **3000 RPM** (engine speed approximately 3600 RPM). Verify pump speed with a phototac.

8. With Kit switch still in the ON position, watch tester pressure gauges while slowly closing flow control valve on the tester until **1500 PSI (103.4 Bar)** is obtained on gauge. Verify that pump speed continues to be **3000 RPM**. Record flow meter reading.

GAUGE READING TO BE: Flow should be approximately **7.9 GPM (29.9 LPM)** at **1500 PSI (103.4 Bar)**.

9. Open tester flow control valve, turn Kit switch OFF and stop engine.

10. If pump flow specification is not met, inspect for:

- A. Slipping pump drive belt.
- B. Worn or stuck relief valve.
- C. Pump suction line restriction.
- D. Gear pump needs to be repaired or replaced.

11. To test High Flow Hydraulic system relief pressure:

- A. Make sure flow control valve on tester is fully open.
- B. Start engine and depress accelerator pedal so engine is running at high idle (**3600 ± 50 RPM**). Turn Kit switch ON.

IMPORTANT: Close flow control valve on tester only enough to get a system relief pressure reading.

- C. Watch pressure gauge carefully while slowly closing the tester flow control valve until the relief valve opens.
- D. System pressure should be approximately **2000 PSI (137.9 Bar)** as the relief valve lifts.
- E. Open tester flow control valve, release accelerator pedal to allow engine to return to low idle and turn Kit switch OFF. Turn off vehicle. Record test results.

12. If relief pressure is incorrect, inspect for:

- A. Slipping pump drive belt.
- B. Worn, stuck or out of adjustment relief valve.

13. Remove tester from quick disconnect couplings.


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Service and Repairs

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Components

1. Before removing any parts from the hydraulic system, park vehicle on a level surface, engage parking brake, and stop engine. Remove key from the ignition switch.
2. Clean vehicle before disconnecting, removing, or disassembling any hydraulic components. Make sure hydraulic components, hoses connections, and fittings are cleaned thoroughly. Always keep in mind the need for cleanliness when working on hydraulic equipment.

**CAUTION**


Before performing any service or repair on hydraulic system components, relieve system pressure to avoid injury from pressurized hydraulic oil. Stop the engine, remove key from the ignition switch, rotate the steering wheel in both directions, lower or support the bed and operate other hydraulic accessories.

3. Put caps or plugs on any hydraulic lines, hydraulic fittings, and components left open or exposed to prevent contamination.
4. Put labels on disconnected hydraulic lines and hoses for proper installation after repairs are completed.
5. Note the position of hydraulic fittings (especially elbow fittings) on hydraulic components before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hydraulic hoses and tubes.

After Repair or Replacement of Components

1. Check oil level in the transaxle and add correct oil if necessary. Drain and refill transaxle and change oil filter if component failure was severe or system is contaminated.
2. Lubricate O-rings and seals with clean hydraulic oil before installing hydraulic components.
3. Make sure caps or plugs are removed from the hydraulic tubes, hydraulic fittings, and components before reconnecting.
4. Use proper tightening methods when installing hydraulic hoses and fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).
5. After disconnecting or replacing any hydraulic components, operate vehicle functions slowly until air is out of system.
6. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in transaxle and add correct oil if necessary.

Check Hydraulic Lines and Hoses

**WARNING**

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings, weather deterioration and chemical deterioration. Make all necessary repairs before operating.

Gear Pump (Vehicles with Liquid Cooled Engine)

Removal (Fig. 20)

1. Park vehicle on a level surface, raise and support bed (if installed), shut engine off and engage parking brake.
2. Loosen pump drive belt and remove belt from pump pulley (see Operator's Manual).
3. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.



CAUTION

Before performing any service or repair on hydraulic system components, relieve system pressure to avoid injury from pressurized hydraulic oil. Stop the engine, remove key from the ignition switch, rotate the steering wheel in both directions, lower or support the bed and operate other hydraulic accessories.

4. Disconnect hydraulic hoses from gear pump (Fig. 21). Install caps or plugs in hoses and pump fittings to prevent contamination and leakage of hydraulic oil.
5. Remove mount plate with pump from vehicle.
6. Remove gear pump from mount plate using Figure 20 as a guide.

Installation (Fig. 20)

1. Install parts as shown in Figure 20 and using the following instructions:

A. Apply antiseize lubricant to gear pump shaft before installing pulley.

B. After installing key and pulley on pump shaft, tighten lock nut (Item 8) to a torque from 130 to 160 in-lb (14.7 to 18.1 N-m).

C. Apply Loctite #242 (or equivalent) to threads of set screw and install set screw into pulley hub. Torque set screw from 27 to 33 in-lb (3 to 3.7 N-m).

D. Install pump suction hose to bottom fitting on pump, then fill pump through pressure port on top of pump, with clean Dexron III ATF.

E. Install pump pressure hose to top fitting on pump.

2. After installing the pump and connecting hydraulic hoses, install belt and adjust belt tension (see Operator's Manual).

3. Check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.
4. Start the engine and operate at idle speed until air is out of hydraulic system.
5. Stop the engine and check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.

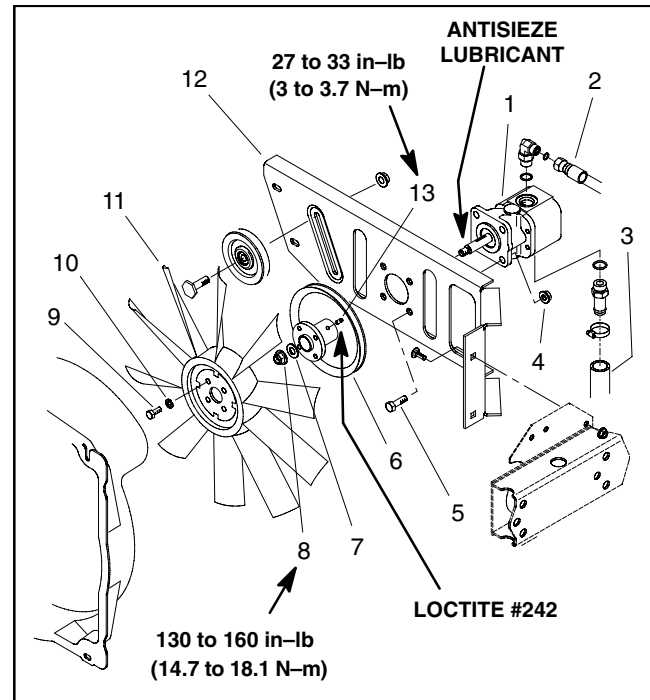


Figure 20

- | | |
|-----------------------|--------------------------|
| 1. Gear pump | 8. Lock nut |
| 2. Pressure hose | 9. Cap screw (4 used) |
| 3. Suction hose | 10. Lock washer (4 used) |
| 4. Lock nut (4 used) | 11. Fan |
| 5. Cap screw (4 used) | 12. Mount plate |
| 6. Pump pulley | 13. Set screw |
| 7. Flat washer | |

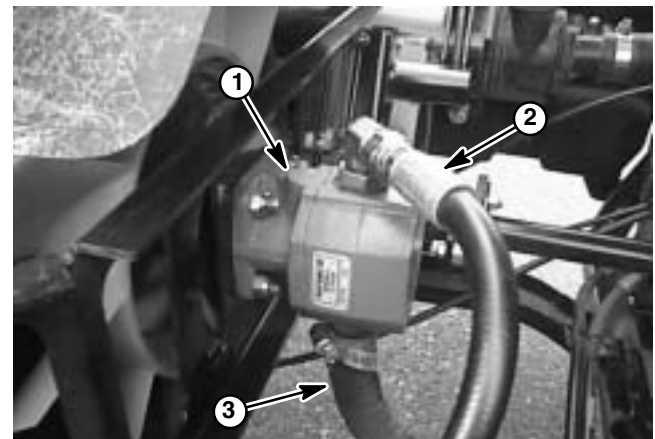


Figure 21

- | | |
|------------------|-----------------|
| 1. Gear pump | 3. Suction hose |
| 2. Pressure hose | |

Gear Pump (Vehicles with Air Cooled Engine)

Removal (Fig. 22)

1. Park vehicle on a level surface, raise and support bed (if installed), shut engine off and engage the parking brake.
2. Loosen pump drive belt and remove belt from pump pulley (see Operator's Manual).
3. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.



CAUTION

Before performing any service or repair on hydraulic system components, relieve system pressure to avoid injury from pressurized hydraulic oil. Stop the engine, remove key from the ignition switch, rotate the steering wheel in both directions, lower or support the bed and operate other hydraulic accessories.

4. Disconnect hydraulic hoses from gear pump. Install caps or plugs in hoses to prevent contamination and leakage of hydraulic oil. Install plugs in pump fittings.
5. Remove gear pump from mount using Figure 22 as a guide.

Installation (Fig. 22)

1. Install gear pump to mount using Figure 22 as a guide and using the following instructions:
 - A. Apply antiseize lubricant to gear pump shaft before installing pulley.
 - B. After installing key and pulley on pump shaft, tighten lock nut (Item 8) to a torque from 130 to 160 in-lb (14.7 to 18.1 N-m).
 - C. Install pump suction hose to fitting on pump, then fill pump through pressure port of pump, with clean Dexron III ATF.
 - D. Install pump pressure hose to fitting on pump.
2. After installing the pump and connecting hydraulic hoses, install belt and adjust belt tension (see Operator's Manual).

3. Check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.
4. Start the engine and operate at idle speed until air is out of hydraulic system.
5. Stop the engine and check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.

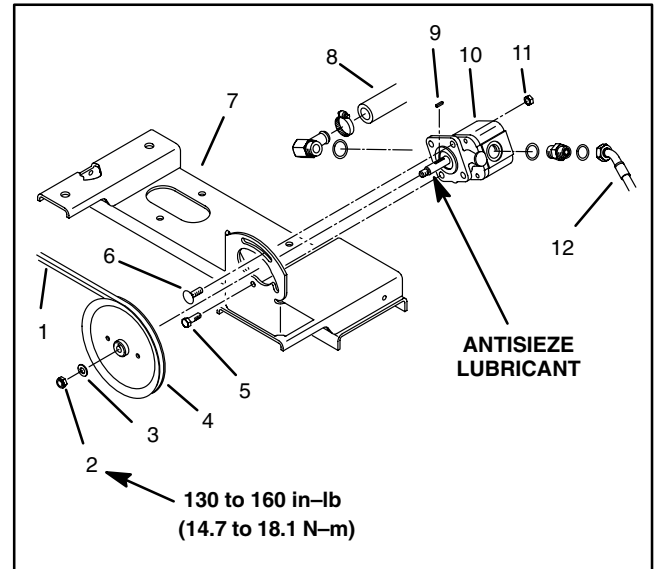


Figure 22

- | | |
|-------------------|-----------------------|
| 1. Drive belt | 7. Mount |
| 2. Lock nut | 8. Suction hose |
| 3. Flat washer | 9. Square key |
| 4. Pump pulley | 10. Gear pump |
| 5. Cap screw | 11. Lock nut (2 used) |
| 6. Carriage screw | 12. Pressure hose |

Gear Pump Service (Barnes Gear Pump)

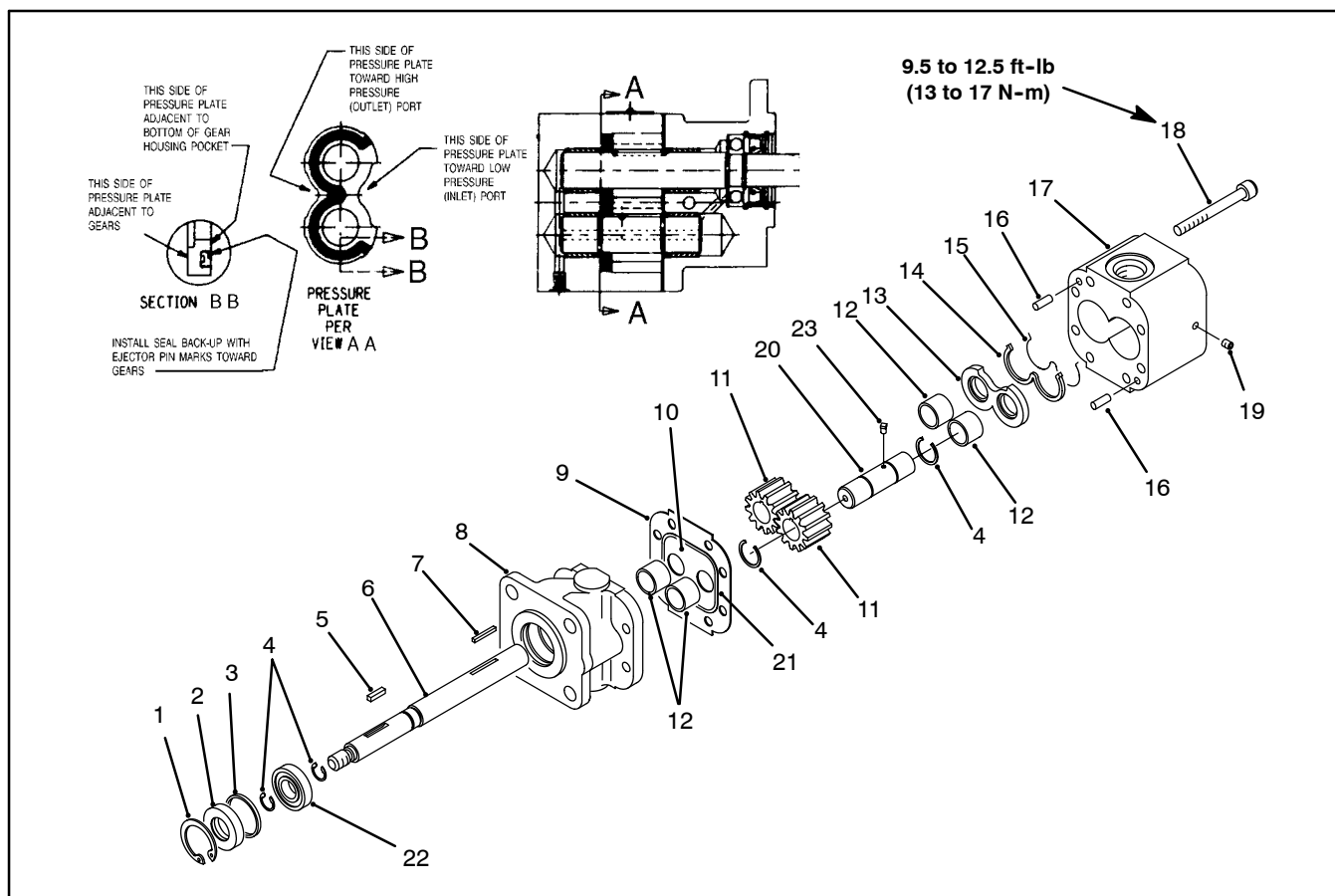


Figure 23

- | | | |
|-------------------|-------------------------|---------------------------|
| 1. Retaining ring | 9. Seal plate | 17. Gear end housing |
| 2. Shaft seal | 10. Wear plate | 18. Socket head cap screw |
| 3. Spacer | 11. Gear | 19. Plug |
| 4. Crescent ring | 12. Bearing | 20. Idler shaft |
| 5. Square key | 13. Pressure plate | 21. Wear plate seal |
| 6. Drive shaft | 14. Back-up seal | 22. Bearing |
| 7. Shear pin | 15. Pressure plate seal | 23. Ball key |
| 8. Stator | 16. Dowel pin | |

Before disassembling gear pump, plug ports, wash exterior of pump with cleaning solvent and dry pump thoroughly.

Shaft Seal Replacement (Fig. 23)

1. Remove retaining ring (Item 1).

2. Punch two (2) holes in face of seal, 180° apart, and install metal screws. Remove shaft seal from gear pump by grasping and pulling on screws.

IMPORTANT: Do not try to pry seal out of housing. This can damage the shaft seal bore so oil will leak past the seal.

3. Discard shaft seal (Item 2). Remove spacer (Item 3).

4. Clean any foreign material from seal bore and drive shaft of pump.

5. Install spacer (Item 3) on driveshaft.

6. Put a seal protector tool on driveshaft or apply thin plastic or tape on shaft to protect new seal from damage.

7. Apply grease or petroleum jelly to inside diameter of new seal.

8. Use a seal installation tool to install new shaft seal (Item 2). Make sure seal is installed square with seal bore.

9. Install retaining ring (Item 1).

Disassembly (Fig. 23)

1. Remove shaft seal (see Shaft Seal Replacement).

IMPORTANT: Use caution when using a vise to avoid distorting any pump components.

2. Secure flange end of pump in a vise with drive shaft (Item 6) facing down.
3. Remove four (4) socket head cap screws (Item 18).
4. Put your hand on gear end housing (Item 17) and gently tap housing with a soft face hammer to loosen from stator (Item 8). Be careful not to drop any parts or disengage gear mesh.
5. Before removing gears (Item 11), apply marking dye to mating teeth to retain gear "timing" and location when reassembling.
6. Remove and discard the pressure plate seal (Item 15), back-up seal (Item 14) and wear plate seal (Item 21) as the pump is disassembled.
7. Press drive shaft and bearing assembly (Item 6, 22, 4) out of stator (Item 8). Remove crescent rings (Item 4) and then remove bearing from drive shaft.

Inspection

1. Wash all parts in cleaning solvent.
2. Check all parts for burrs, scoring, nicks, etc.
3. Check bearings (Item 12) in stator and gear end housing for excessive wear or scoring. Replace the bearings if necessary. Replace wear plate (Item 10) if it appears scored, then stone face of gears. Replace gears (Item 11) if excessively worn or damaged.
4. Check bearing (Item 22) for smooth operation. Replace bearing if loose on shaft or noisy when rotated.
5. Inspect square key (Item 5), shear pin (Item 7), ball key (Item 23) and keyways in shafts for wear or damage. Replace parts as necessary.

Assembly (Fig. 23)

1. Install one crescent ring (Item 4) on inside portion of driveshaft (Item 6), then install bearing (Item 22) and other crescent ring. Install driveshaft and bearing assembly into stator (Item 8).
2. Apply Dexron III ATF to wear plate (Item 10) and install on stator.
3. Install one crescent ring (Item 4) to idler shaft, then install ball key (Item 23), gear (Item 11) and other crescent ring. Make sure to maintain the original gear location. Apply Dexron III ATF to gear and idler shaft assembly, then install into stator.
4. Install shear pin (Item 7), then apply Dexron III ATF to remaining gear and install to drive shaft (Item 6) maintaining the original timing and locations.
5. Apply Dexron III ATF to pressure plate seal (Item 15), back-up seal (Item 14) and pressure plate (Item 13), then install into gear end housing.
6. Install dowel pins (Item 16). Apply Dexron III ATF to seal plate (Item 9) and wear plate seal (Item 21), then install. Assemble gear end housing (Item 17) to stator (Item 8).
7. Install four (4) cap screws (Item 18) and tighten in a crossing pattern from 9.5 to 12.5 ft-lb (13 to 17 N-m).
8. Install shaft seal (see Shaft Seal Replacement).

Gear Pump Service (Casappa Gear Pump)

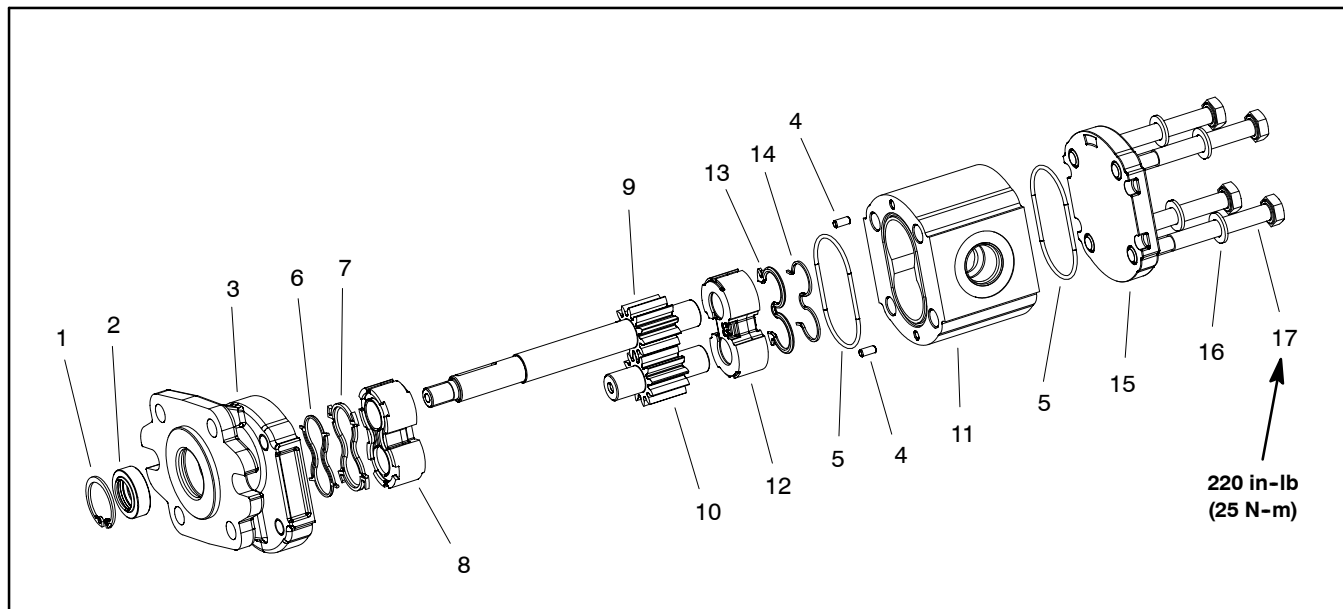


Figure 23.1

- | | | |
|--------------------|-----------------------|--------------------------|
| 1. Retaining ring | 7. Pressure seal | 13. Pressure seal |
| 2. Shaft seal | 8. Front thrust plate | 14. Back-up seal |
| 3. Front cover | 9. Drive shaft | 15. Rear flange |
| 4. Dowel pin | 10. Idler shaft | 16. Lock washer (4 used) |
| 5. O-ring (2 used) | 11. Body | 17. Screw (4 used) |
| 6. Back-up seal | 12. Rear thrust plate | |

Disassembly (Fig. 23.1)

1. Plug pump ports and clean the outside of the pump thoroughly. After cleaning, remove plugs and drain any oil out of the pump.

2. Use a marker to make a **diagonal** line across the front thrust plate, body and rear flange for assembly purposes (Fig. 23.2).

IMPORTANT: Prevent damage when clamping the gear pump in a vise; clamp on the front thrust plate only. Also, use a vise with soft jaws.

3. Clamp front thrust plate of pump in a vise with soft jaws with the shaft end down.

4. Loosen, but do not remove, screws that secure rear flange to pump.

5. Remove pump from the vise and position pump so that the shaft end is facing down. Remove screws.

6. Carefully lift rear flange from body.

7. Carefully remove body. Lift body straight up to remove. Make sure the rear thrust plate remains on the drive and idler gear shafts. Locate and retrieve dowel pins.

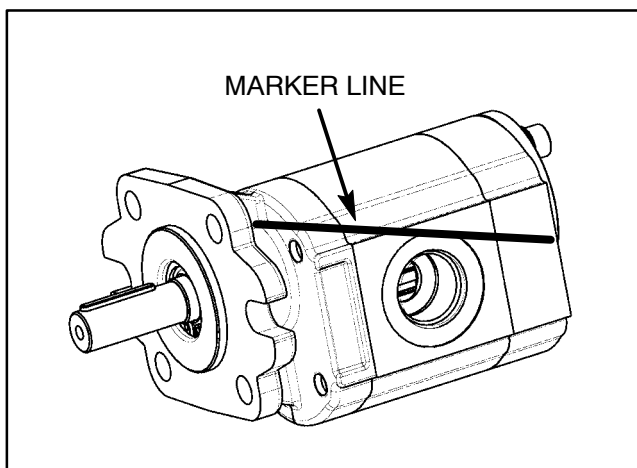


Figure 23.2

IMPORTANT: Note position of the open and closed side of the thrust plates before removing. Also, identify thrust plates (front and rear) with a marker for proper assembly.

8. Carefully remove rear thrust plate, idler shaft, drive shaft and front thrust plate from the front cover.

9. Remove and discard O-rings, back-up seals and pressure seals from pump.

IMPORTANT: Make sure to not damage the seal bores when removing the seal from the front cover and rear flange.

10. Carefully remove retaining ring and shaft seal from front cover. Discard seal.

Inspection

1. Remove any nicks and burrs from all parts with emery cloth.



2. Clean all parts with solvent. Dry all parts with compressed air.

3. Inspect drive and idler shafts for the following (Fig. 23.3):

A. Gear shafts should be free of rough surfaces and excessive wear at bushing points and sealing areas. Scoring, rough surfaces or wear on gear shafts indicates need for replacement.

B. Gear teeth should be free of excessive scoring and wear. Any broken or nicked gear teeth must be replaced.

C. Inspect gear face edge for sharpness. Sharp edges of gears will mill into wear plates and, thus, must be replaced.

4. Inspect thrust plates for the following:

A. Bearing areas should not have excessive wear or scoring.

B. Face of thrust plates that are in contact with gears should be free of wear, roughness or scoring.

C. Thickness of thrust plates should be equal.

5. Inspect front cover and rear flange for damage or wear.

Assembly (Fig. 23.1)

NOTE: When assembling the pump, check the marker line on each part to make sure the pump components are properly aligned during assembly (Fig. 23.2).

1. Lubricate O-rings, pressure seals, back-up seals and thrust plate grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean Dexron III ATF.

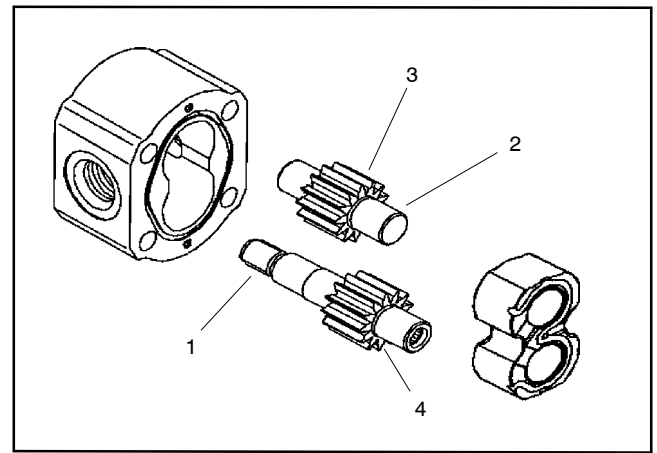


Figure 23.3

- | | |
|----------------------|-------------------|
| 1. Gear shaft spline | 3. Gear teeth |
| 2. Gear shaft | 4. Gear face edge |

2. Press new shaft seal into front cover until it reaches the bottom of the bore and secure with retaining ring.

3. Install the lubricated pressure and backup seals into the grooves in the front and rear thrust plates. Install lubricated O-rings to the body.

4. Place front cover, seal side down, on a flat surface. Apply a light coating of petroleum jelly to the exposed side of the front cover.

5. Lubricate the drive shaft with clean Dexron III ATF. Carefully insert the drive end of the drive shaft through the front thrust plate with the pressure seal side down.

IMPORTANT: When installing drive shaft into front cover, make sure that shaft seal (item 2) is not damaged.

6. Carefully install shaft with front thrust plate into front cover taking care to not damage shaft seal.

7. Lubricate the idler shaft with clean Dexron III ATF. Install idler shaft into the remaining position in the front thrust plate. Apply a light coating of clean hydraulic oil to gear faces.

8. Install rear thrust plate with pressure seal side up and open side of the seals pointing to the inlet side of the pump.

9. Install two (2) dowel pins into front cover. Align marker line on the body and front cover.

IMPORTANT: Do not dislodge seals during installation.

10. Gently slide the body onto the assembly. Firm hand pressure should be sufficient to engage the dowel pins.

11. Align marker line on the body and rear flange.

12. Carefully install rear flange onto pump assembly.

13. Install the four (4) screws (item 17) with lock washers and hand tighten.

IMPORTANT: Prevent damage when clamping the pump into a vise; clamp on the front cover only. Also, use a vise with soft jaws.

14. Place front cover of the pump into a vise with soft jaws and alternately torque the cap screws 220 in-lb (25 N-m).

15. Remove pump from vise.

16. Place a small amount of clean Dexron III ATF in the inlet of the pump and rotate the drive shaft away from the inlet one revolution. If any binding is noted, disassemble the pump and check for assembly problems.

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Lift Valve

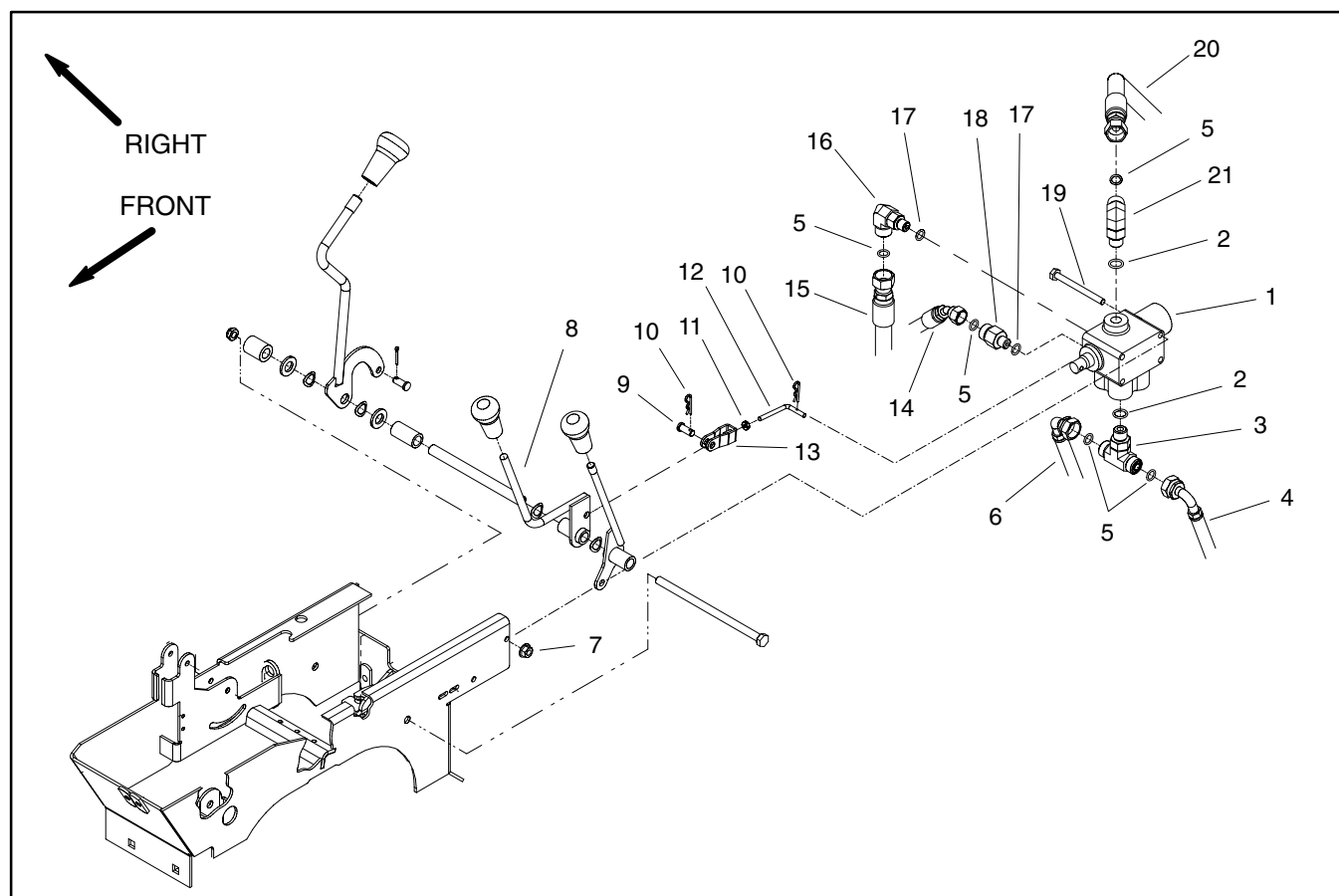


Figure 24

- | | | |
|---|---------------------------------------|---|
| 1. Lift valve | 8. Lift lever | 15. Hyd. hose (to female quick fitting) |
| 2. O-ring | 9. Clevis pin | 16. 90° hydraulic fitting |
| 3. Tee fitting | 10. Hairpin | 17. O-ring |
| 4. Hyd. hose (steering circuit return) | 11. Jam nut | 18. Hydraulic adapter |
| 5. O-ring | 12. Link rod | 19. Cap screw |
| 6. Hyd. hose (return to hydraulic filter) | 13. Clevis | 20. Hyd. hose (pressure supply) |
| 7. Flange nut | 14. Hyd. hose (to male quick fitting) | 21. 90° hydraulic fitting |

Removal (Fig. 24)

1. Park vehicle on a level surface, raise and support bed (if installed), shut engine off and engage the parking brake.
2. Remove seat base from vehicle (see Seat Base Removal in the Service and Repairs section of Chapter 7 – Chassis).
3. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.



CAUTION

Before performing any service or repair on hydraulic system components, relieve system pressure to avoid injury from pressurized hydraulic oil. Stop the engine, remove key from the ignition switch, rotate the steering wheel in both directions, lower or support the bed and operate other hydraulic accessories.

4. Label and disconnect hydraulic hoses from lift valve. Install caps or plugs in hoses to prevent contamination and leakage of hydraulic oil. Install plugs in valve ports.
5. Remove lift valve from vehicle using Figure 24 as a guide.

Installation (Fig. 24)

1. Install lift valve to vehicle using Figure 24 as a guide. Make sure that lift lever can be moved in control plate slot to allow correct operation of lift lock. Readjust location of clevis on link rod if needed (Fig. 25).
2. Replace o-rings on hydraulic hoses and fittings. Remove caps and plugs from hoses and fittings. Connect hydraulic hoses to lift valve.
3. Install seat base to vehicle (see Seat Base Installation in the Service and Repairs section of Chapter 7 – Chassis).
4. Check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.
5. Start the engine, operate at idle speed and operate the lift lever in both directions until air is out of hydraulic system.
6. Stop the engine and check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.
7. On TC models, verify correct operation of lift lever interlock switch.

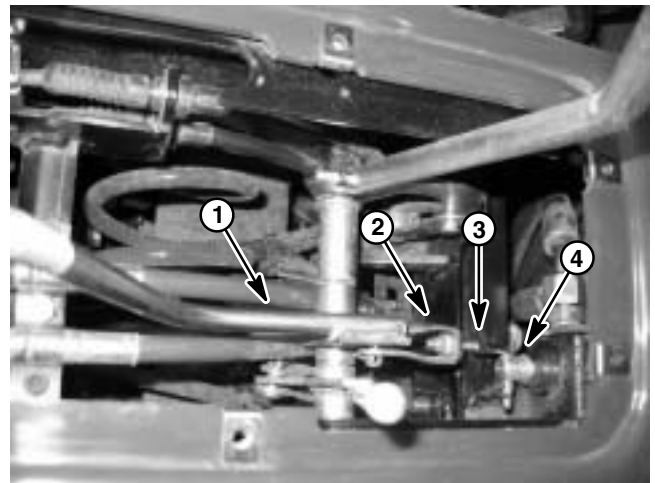


Figure 25

- | | |
|---------------|---------------------|
| 1. Lift lever | 3. Link rod |
| 2. Clevis | 4. Lift valve spool |

Lift Valve Service

Disassembly (Fig. 26)

1. After removing lift valve from vehicle, wash valve in solvent and dry thoroughly.
2. Carefully mount lift valve in a vise so that mounting pads are against jaws of vise. Lift valve spool retaining ring (Item 14) should be facing up.
3. Remove two (2) hex cap plugs (Item 1) from side of valve body. Inside valve body, behind each hex cap plug, there is a spring (Item 3), ball (Item 4) and cam pin (Item 6); remove these parts.

NOTE: Remove check ball seats (Item 5) only if they need replacement; the seats are press fit into the valve body.

4. Remove retaining ring (Item 14) from spool (Item 8). Remove spool retaining ring (Item 13), spring retainer (Item 10), spacer (Item 12), spring (Item 11) and second spool retaining ring (Item 13). Carefully push and twist spool to remove spool from valve body.

5. Use a hooked scribe or thin screwdriver to remove o-rings (Item 9) from inside bore of valve body (be careful not to scratch valve bore finish). These o-rings are the seals for the spool.

6. Inspect all components for wear, paying special attention to the spool. Signs of wear on one side of the spool may indicate a bent spool. Inspect the spool for flatness and replace if necessary.

Assembly (Fig. 26)

1. Clean all components thoroughly before assembly. Use new o-rings when reassembling.
2. Coat all o-rings and spool with clean Dexron III ATF before installation into valve body. Assemble components in reverse order of disassembly. Install spool into valve body before inserting cam pins, balls, springs and hex cap plugs.

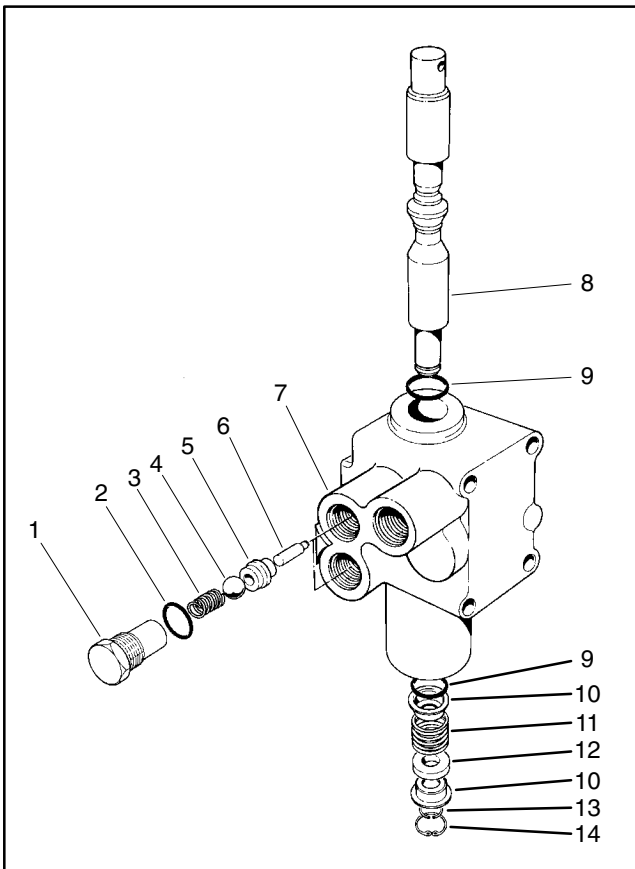


Figure 26

- | | |
|-----------------------------|--------------------------|
| 1. Hex cap plug (2 used) | 8. Spool |
| 2. O-ring (2 used) | 9. O-ring |
| 3. Spring (2 used) | 10. Spring retainer |
| 4. Check ball (2 used) | 11. Spring |
| 5. Check ball seat (2 used) | 12. Spacer |
| 6. Cam pin (2 used) | 13. Spool retaining ring |
| 7. Valve body | 14. Retaining ring |

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Steering Control Valve

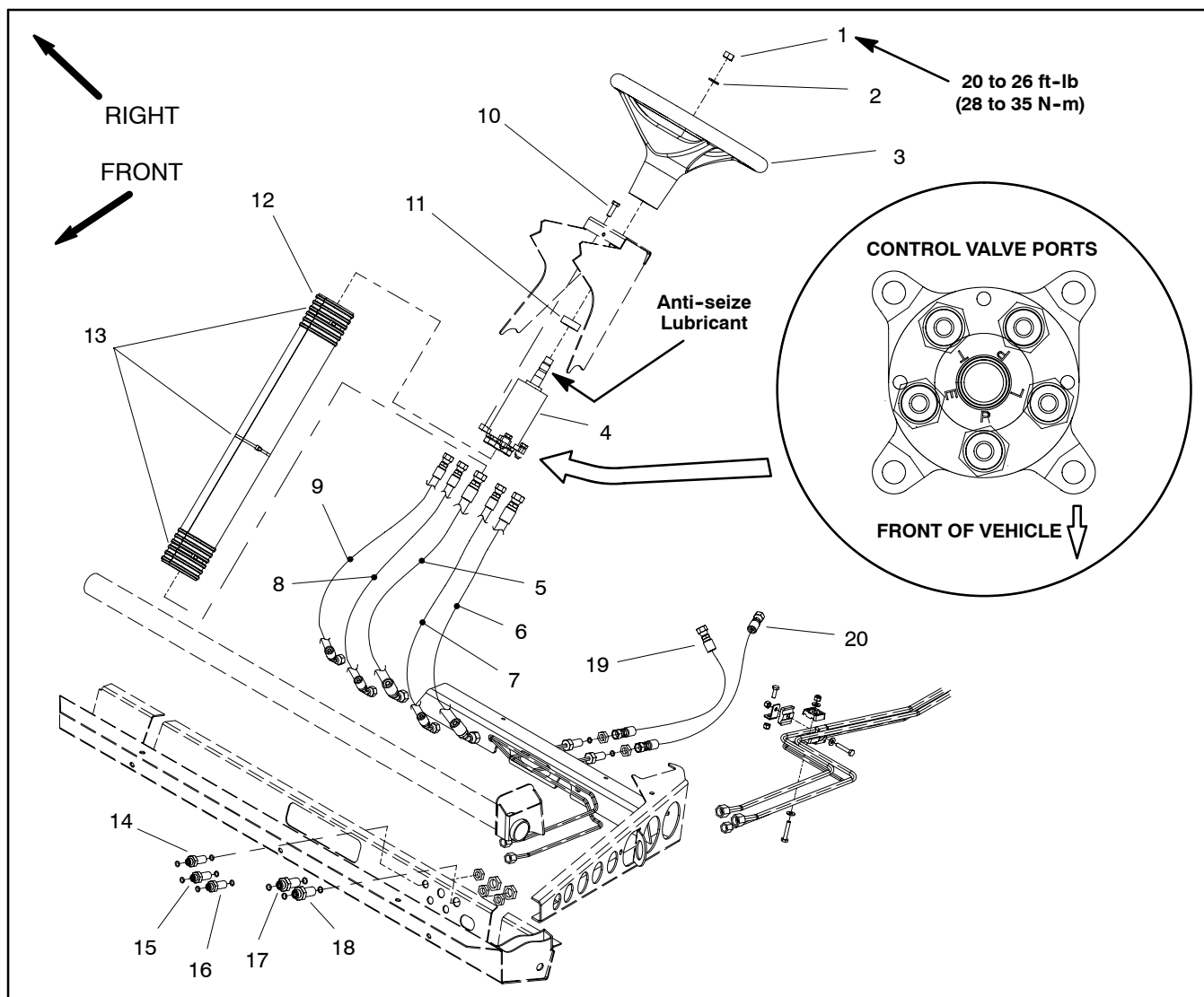


Figure 27

- | | | |
|---------------------------------------|--|--|
| 1. Hex nut | 8. Hyd hose (to control valve R port) | 15. Bulkhead fitting (to valve R port) |
| 2. Lock washer | 9. Hyd hose (to control valve L port) | 16. Bulkhead fitting (to valve T port) |
| 3. Steering wheel | 10. Cap screw (4 used) | 17. Bulkhead fitting (to valve P port) |
| 4. Steering control valve | 11. Dust cover | 18. Bulkhead fitting (to valve E port) |
| 5. Hyd hose (to control valve P port) | 12. Steering hose cover | 19. Hyd hose (to steer cyl shaft end) |
| 6. Hyd hose (to control valve E port) | 13. Cable tie | 20. Hyd hose (to steer cyl barrel end) |
| 7. Hyd hose (to control valve T port) | 14. Bulkhead fitting (to valve L port) | |

Removal (Fig. 27)

1. Park vehicle on a level surface, shut engine off and engage the parking brake.

2. Remove steering wheel (see Steering Wheel Removal in the Service and Repairs section of Chapter 7 - Chassis).

3. Remove cable ties that secure steering hose cover to hydraulic hoses. Remove cover from hoses.

4. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.



CAUTION

Before performing any service or repair on hydraulic system components, relieve system pressure to avoid injury from pressurized hydraulic oil. Stop the engine, remove key from the ignition switch, rotate the steering wheel in both directions, lower or support the bed and operate other hydraulic accessories.

5. Raise dash to gain access to steering control (Fig. 28):

A. Remove seven (7) screws (item 2) that secure hood and dash to frame.

B. Remove two (2) cap screws (item 5) and flat washers (item 4) that secure dash to steering control.

C. Carefully lift dash to allow steering control removal.

6. Remove steering control valve from vehicle frame by removing four (4) cap screws.

7. Remove cable ties that secure cover (item 12) over hydraulic hoses. Remove cover from hoses.

8. Label and disconnect hydraulic hoses from steering control valve (refer to Figures 27 and 29). Install caps or plugs in hoses to prevent contamination and leakage of hydraulic oil. Install plugs in valve ports.

Installation (Fig. 27)

1. Replace o-rings on hydraulic hoses and fittings. Remove caps and plugs from hoses and fittings. Connect hydraulic hoses to correct steering control valve ports (refer to Figures 27 and 29). Make sure that hoses are not twisted while tightening.

2. Secure steering control valve to vehicle with four (4) cap screws.

3. Install hydraulic hose cover over hoses and secure with cable ties.

4. Position dash and hood to frame (Fig. 28). Secure with seven (7) screws and two (2) cap screws with flat washers.

5. Install steering wheel (see Steering Wheel Installation in the Service and Repairs section of Chapter 7 – Chassis).

6. Check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.

7. Start the engine, operate at idle speed and rotate the steering wheel in both directions until air is out of hydraulic system.

8. Stop the engine and check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.

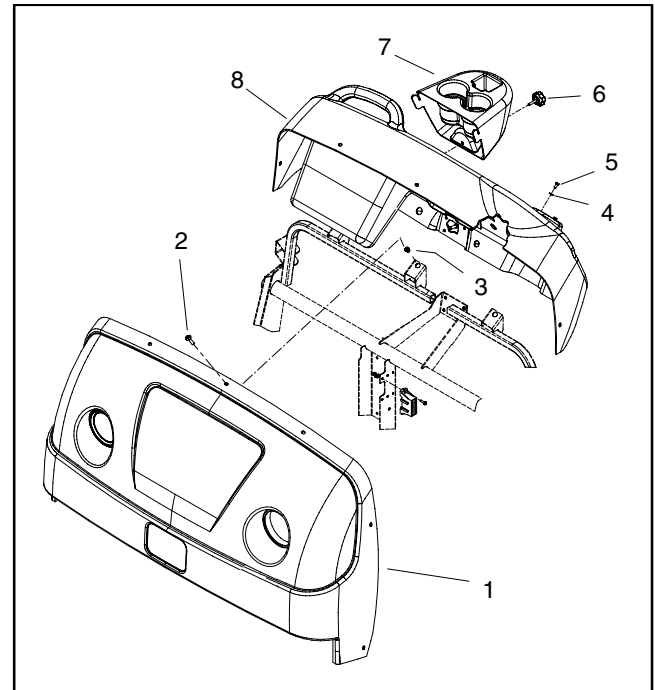


Figure 28

- | | |
|-------------------------|-----------------------|
| 1. Hood | 5. Cap screw (2 used) |
| 2. Screw (7 used) | 6. Knob |
| 3. Well nut (7 used) | 7. Cover |
| 4. Flat washer (2 used) | 8. Dash |

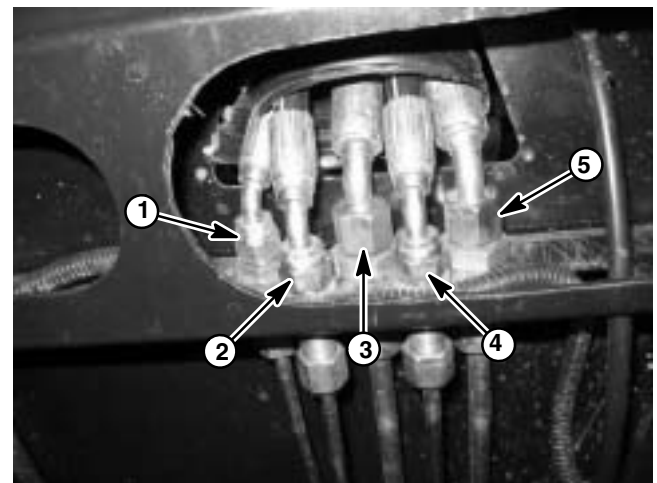


Figure 29

- | | |
|-----------------------|-----------------------|
| 1. Hyd hose to L port | 4. Hyd hose to T port |
| 2. Hyd hose to R port | 5. Hyd hose to E port |
| 3. Hyd hose to P port | |

Steering Control Valve Service

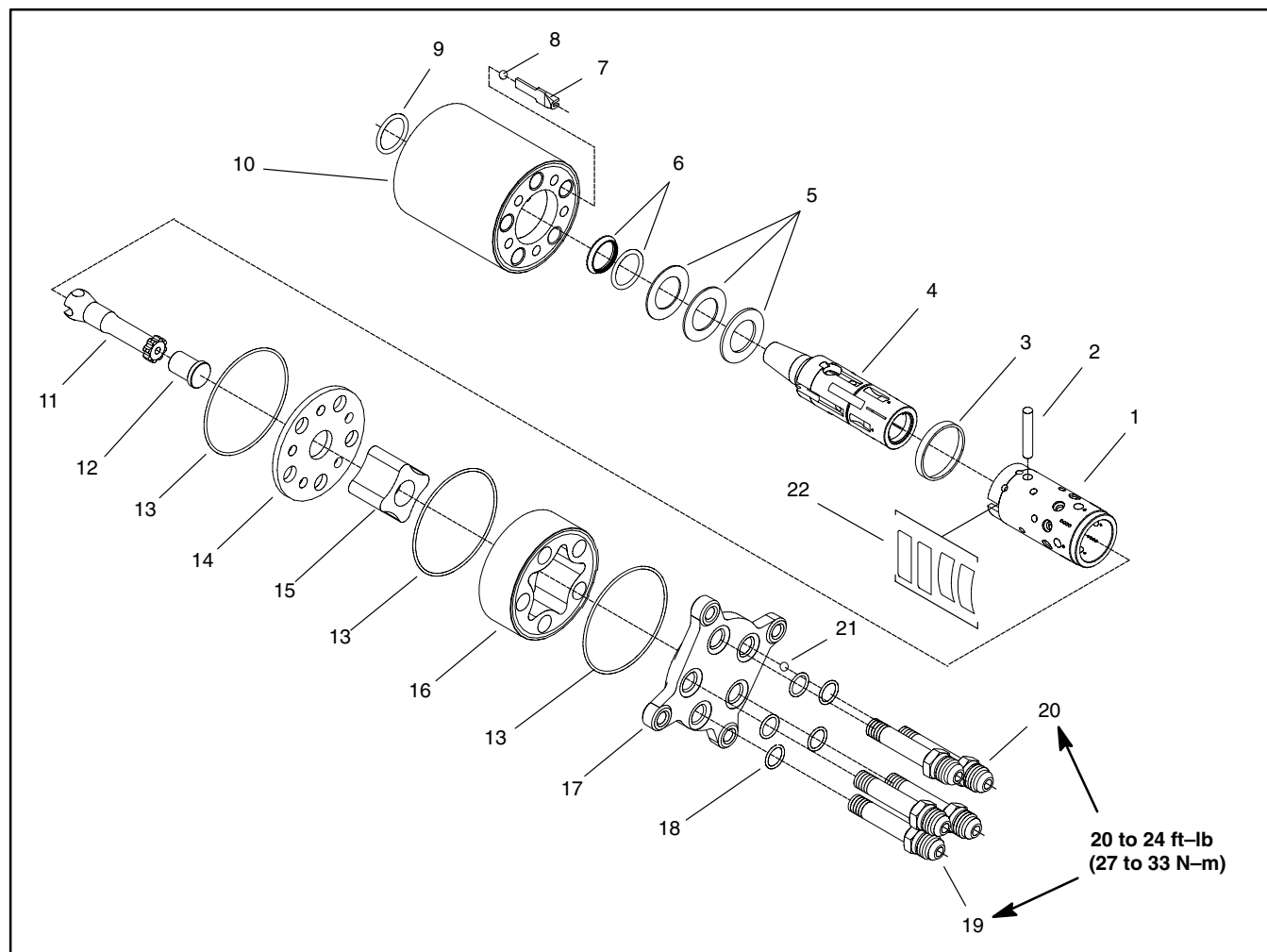


Figure 30

- | | | |
|---------------------|------------------------|-----------------------------------|
| 1. Sleeve | 9. Dust seal ring | 16. Outer gearwheel |
| 2. Cross pin | 10. Housing | 17. End cover |
| 3. Ring | 11. Cardan shaft | 18. O-ring (5 used) |
| 4. Spool | 12. Spacer | 19. Screw/fitting (ports L, R, T) |
| 5. Bearing assembly | 13. O-ring | 20. Screw/fitting (ports P and E) |
| 6. Shaft seal | 14. Distribution plate | 21. P port check ball |
| 7. Ball stop | 15. Inner gearwheel | 22. Spring set |
| 8. Ball | | |

NOTE: For service of the steering control valve, see the Sauer/Danfoss Steering Unit Type OSPM Service Manual at the end of this chapter.

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Steering Cylinder

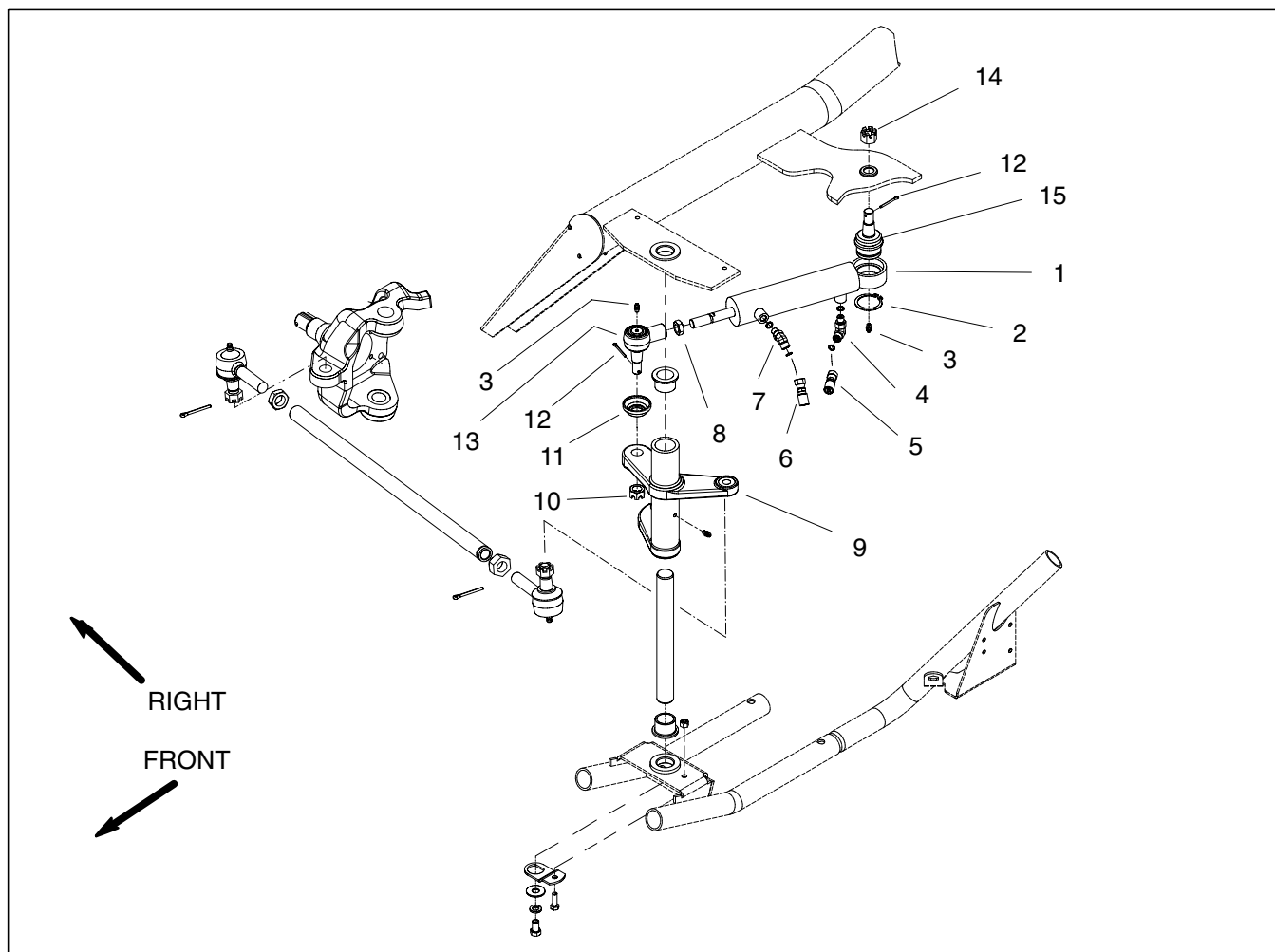



Figure 31

- | | | |
|--------------------------------------|--------------------------------------|---------------------|
| 1. Steering cylinder | 6. Hyd. hose (from steering valve L) | 11. Dust seal |
| 2. Retaining ring | 7. 45° hydraulic fitting | 12. Cotter pin |
| 3. Grease fitting | 8. Jam nut | 13. Ball joint |
| 4. 90° hydraulic fitting | 9. Pitman arm | 14. Slotted hex nut |
| 5. Hyd. hose (from steering valve R) | 10. Slotted hex nut | 15. Ball joint |

Removal (Fig. 31)

1. Park vehicle on a level surface, shut engine off and engage the parking brake.
2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

**CAUTION**

Before performing any service or repair on hydraulic system components, relieve system pressure to avoid injury from pressurized hydraulic oil. Stop the engine, remove key from the ignition switch, rotate the steering wheel in both directions, lower or support the bed and operate other hydraulic accessories.

3. Label and disconnect hydraulic hoses from steering cylinder. Install caps or plugs in hoses to prevent contamination and leakage of hydraulic oil. Install plugs in cylinder ports.
4. Remove steering cylinder from vehicle using Figures 31 and 32 as guides.

Installation (Fig. 31)

1. If ball joint was removed from cylinder shaft, fully retract cylinder shaft and thread ball joint onto shaft. Adjust center to center length to dimension shown in Figure 33 before tightening jam nut. Torque jam nut 50 ft-lb (68 N-m).
2. Install steering cylinder to vehicle using Figures 31 and 32 as guides.
3. Replace o-rings on hydraulic hoses and fittings. Remove caps and plugs from hoses and fittings. Connect hydraulic hoses to steering cylinder.
4. Check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.
5. Start the engine, operate at idle speed and rotate the steering wheel in both directions until air is out of hydraulic system.
6. Stop the engine and check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.
7. Check front wheel alignment and adjust as needed (see Front Wheel Alignment in the Service and Repair section of Chapter 7 - Chassis).

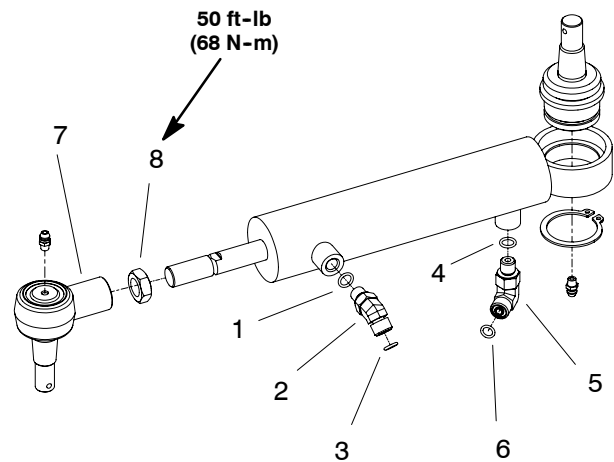


Figure 32

- | | |
|--------------------------|--------------------------|
| 1. O-ring | 5. 90° hydraulic fitting |
| 2. 45° hydraulic fitting | 6. O-ring |
| 3. O-ring | 7. Ball joint |
| 4. O-ring | 8. Jam nut |

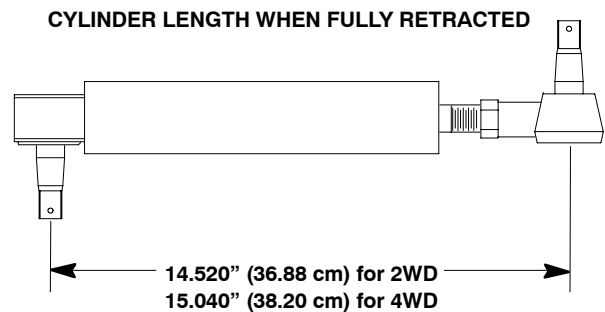


Figure 33

Steering Cylinder Service

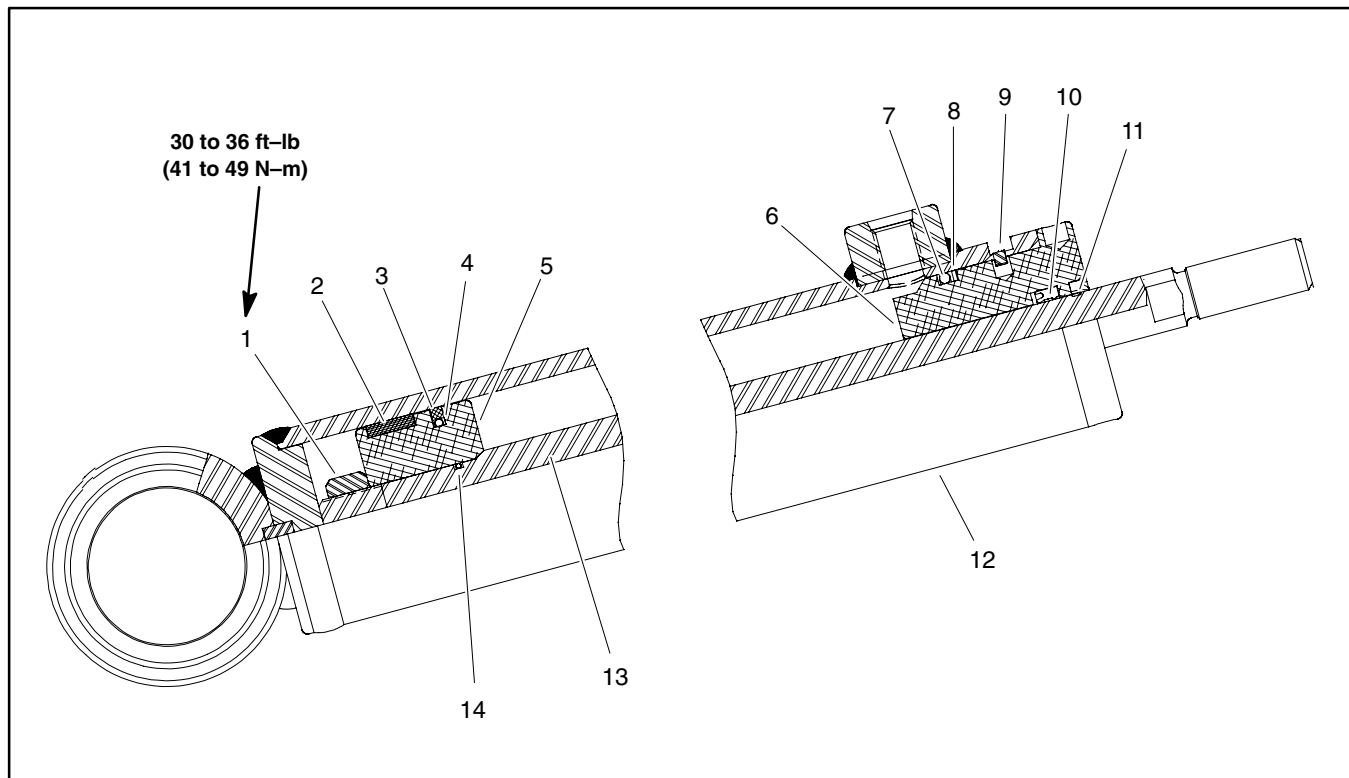


Figure 34

Disassembly (Fig. 34)

1. Pump oil out of cylinder into a drain pan by slowly moving piston back and forth.

2. Before disassembling cylinder, plug ports, wash exterior with cleaning solvent and dry thoroughly.

IMPORTANT: Use caution when using a vise to avoid scratching or distorting any parts.

3. Put cylinder in a vise so shaft end is facing up.

4. Use a spanner wrench to rotate head (Item 6) and remove retaining ring (Item 9). Grasp end of shaft and use a twisting and pulling motion to carefully extract the piston, shaft and head assembly from the barrel.

5. Remove cylinder from vise.

6. Remove lock nut (Item 1) from shaft, then remove piston (Item 5), and head (Item 6). Remove and discard seals, o-rings, wear ring and wiper from piston and head.

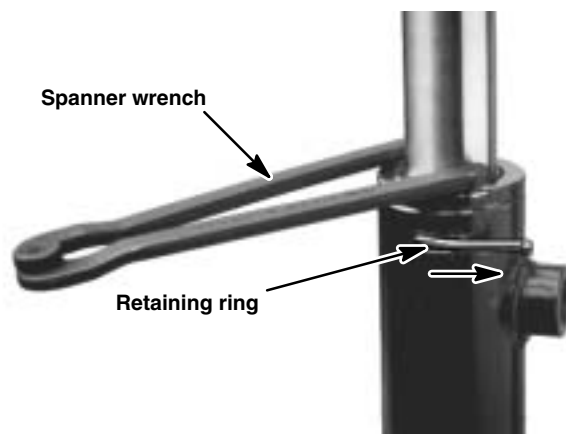


Figure 35
Removing retaining ring

Inspection

1. Inspect head (Item 6), piston (Item 5) and shaft (Item 13) for excessive scoring, pitting or wear. Replace any worn or damaged parts.
2. Inspect inside of barrel for scoring, pitting or out-of-round and replace if worn or damaged.

Assembly (Fig. 34)

1. Use a new seal kit to replace all seals, o-rings, wear ring and wiper to piston and head. Apply clean Dexron III ATF to all seal kit components before installing.
2. Install head (Item 6) with new seals onto shaft (Item 13). Install piston (Item 5) with new seals and back-ups onto shaft. Install piston onto shaft and secure with lock nut (Item 1). Torque lock nut from 30 to 36 ft-lb (41 to 49 N-m).
3. Coat all cylinder parts with clean Dexron III ATF. Slide shaft assembly and head into barrel, being careful not to damage seals.
4. Install retaining ring (Item 9) to secure shaft assembly in barrel. To install retaining ring, align key slot in head with access groove in barrel. Rotate head clockwise as far as the retaining ring will allow. Offset end of retaining ring will be against left side of barrel groove as shown.

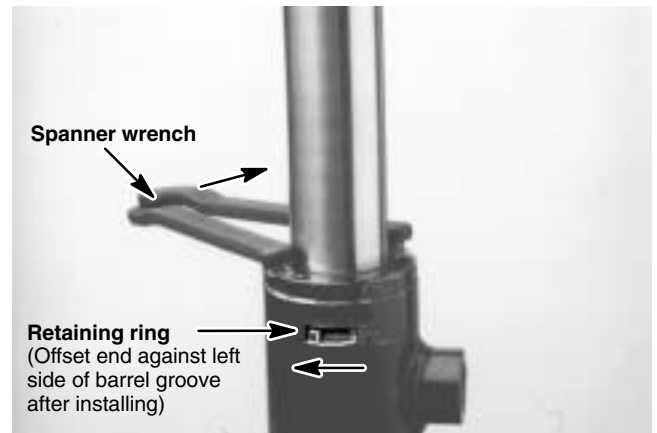


Figure 36
Installing retaining ring

Lift Cylinder

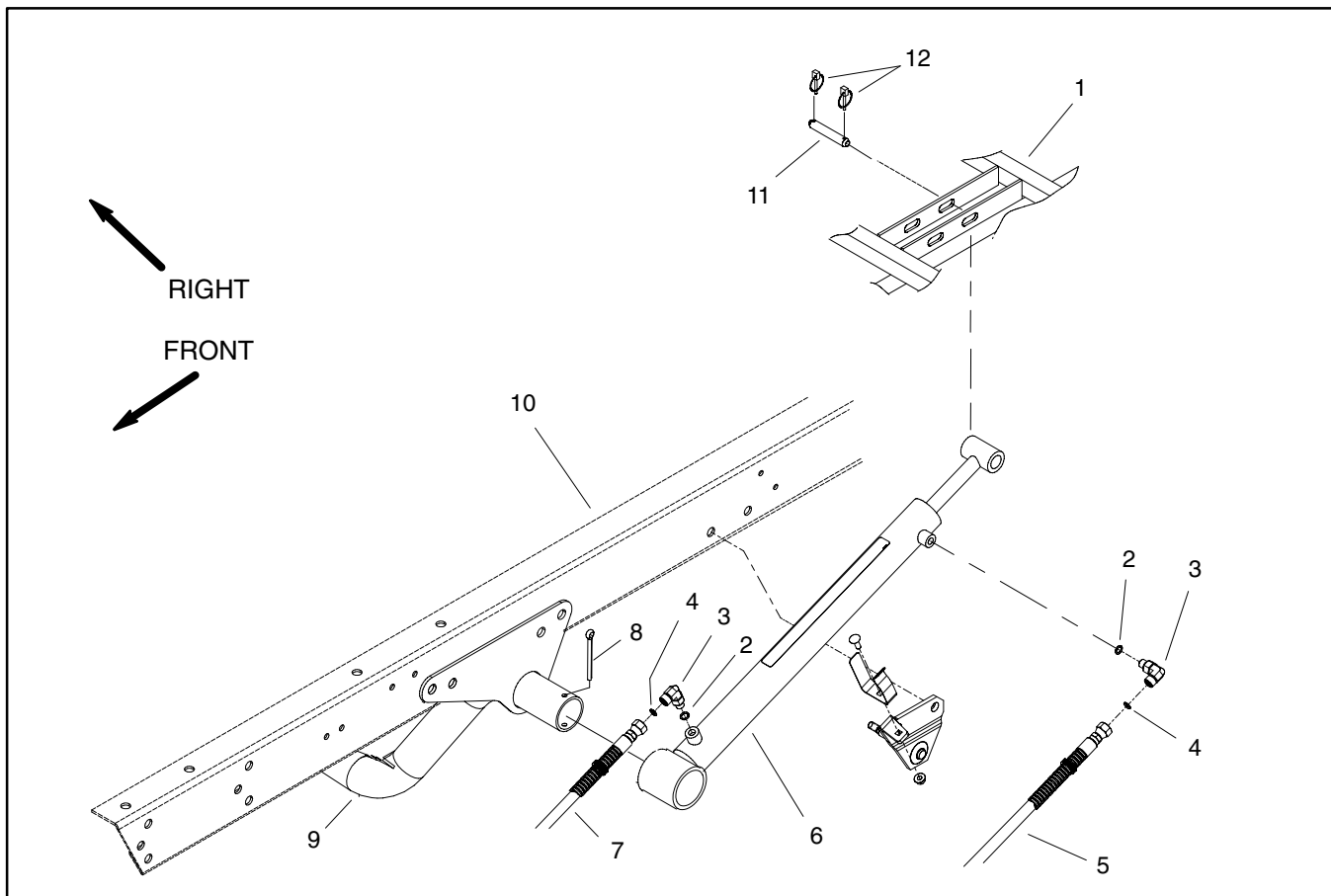
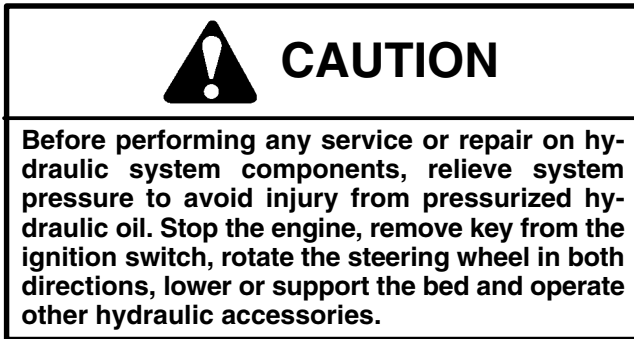


Figure 37

- | | | |
|----------------------|-----------------------------|---------------------------|
| 1. Box frame | 5. Hydraulic hose | 9. Engine support |
| 2. O-ring | 6. Lift cylinder (LH shown) | 10. Frame rail (LH shown) |
| 3. Hydraulic fitting | 7. Hydraulic hose | 11. Clevis pin |
| 4. O-ring | 8. Cotter pin | 12. Lynch pin |

Removal (Fig. 37)

1. Park vehicle on a level surface, lower bed until clevis pins that secure lift cylinder to bed are loose in the bed slots. Shut engine off and engage the parking brake.
2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.



3. Disconnect hydraulic hoses from lift cylinder. Install caps or plugs in hoses to prevent contamination and leakage of hydraulic oil. Install plugs in cylinder ports.
4. Remove lynch pin and clevis pin that secure lift cylinder to bed.
5. Remove cotter pin that secures lift cylinder to engine support.
6. Remove lift cylinder from vehicle.

Installation (Fig. 37)

1. Make sure that lift cylinder is fully retracted.
2. Position lift cylinder to vehicle. Secure lift cylinder to bed with clevis pin and lynch pins and to engine support with cotter pin.
3. Remove plugs and/or caps from hydraulic hoses and cylinder ports. Connect hydraulic hoses to lift cylinder.
4. Start the engine, operate at idle speed and raise and lower bed until air is out of hydraulic system.
5. Stop the engine and check oil level in transaxle (see Operator's Manual). Add Dexron III ATF if necessary.

Lift Cylinder Service

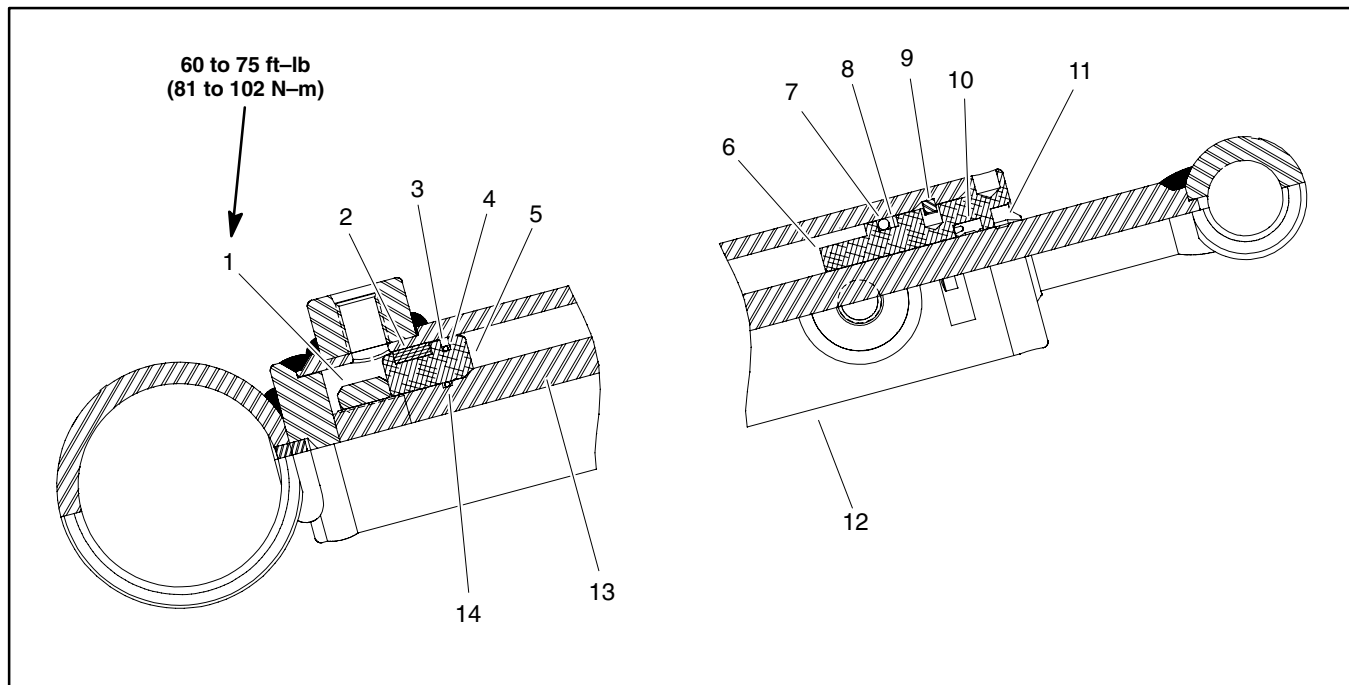


Figure 38

- | | | |
|--------------|-------------------|------------|
| 1. Lock nut | 6. Head | 11. Wiper |
| 2. Wear ring | 7. O-ring | 12. Barrel |
| 3. Seal | 8. Back-up seal | 13. Shaft |
| 4. O-ring | 9. Retaining ring | 14. O-ring |
| 5. Piston | 10. Seal | |

Disassembly (Fig. 38)

1. Pump oil out of cylinder into a drain pan by slowly moving piston back and forth.

2. Before disassembling cylinder, plug ports, wash exterior with cleaning solvent and dry thoroughly.

IMPORTANT: Use caution when using a vise to avoid scratching or distorting any parts.

3. Put cylinder in a vise so shaft end is facing up.

4. Use a spanner wrench to rotate head (Item 6) and remove retaining ring (Item 9). Grasp end of shaft and use a twisting and pulling motion to carefully extract the piston, shaft and head assembly from the barrel.

5. Remove cylinder from vise.

6. Remove lock nut (Item 1) from shaft, then remove piston (Item 5), and head (Item 6). Remove and discard seals, o-rings, wear ring and wiper from piston and head.

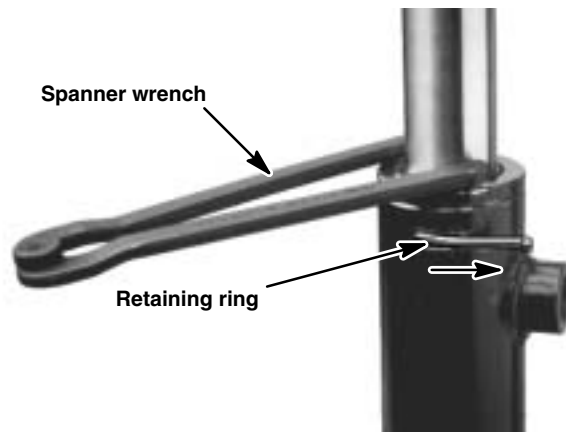


Figure 39
Removing retaining ring

Inspection

1. Inspect head (Item 6), piston (Item 5) and shaft (Item 13) for excessive scoring, pitting or wear. Replace any worn or damaged parts.
2. Inspect inside of barrel for scoring, pitting or out-of-round and replace if worn or damaged.

Assembly (Fig. 38)

1. Use a new seal kit to replace all seals, o-rings, wear ring and wiper to piston and head. Apply clean Dexron III ATF to all seal kit components before installing.
2. Install head (Item 6) with new seals onto shaft (Item 13). Install piston (Item 5) with new seals and back-ups onto shaft. Install piston onto shaft and secure with lock nut (Item 1). Torque lock nut from 60 to 75 ft-lb (81 to 102 N-m).
3. Coat all cylinder parts with clean Dexron III ATF. Slide shaft assembly and head into barrel, being careful not to damage seals.
4. Install retaining ring (Item 9) to secure shaft assembly in barrel. To install retaining ring, align key slot in head with access groove in barrel. Rotate head clockwise as far as the retaining ring will allow. Offset end of retaining ring will be against left side of barrel groove as shown.

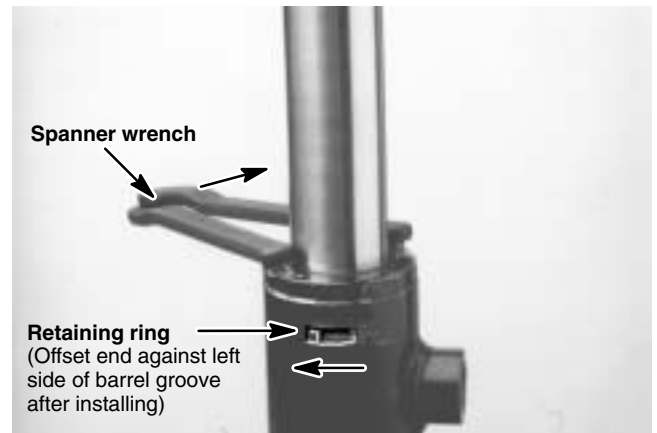


Figure 40
Installing retaining ring

Hydraulic Manifold (Optional High Flow Hydraulic Kit)

Removal (Fig. 41)

1. Park vehicle on a level surface, raise bed, shut engine off and engage the parking brake.
2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.



CAUTION

Before performing any service or repair on hydraulic system components, relieve system pressure to avoid injury from pressurized hydraulic oil. Stop the engine, remove key from the ignition switch, rotate the steering wheel in both directions, lower or support the bed and operate other hydraulic accessories.

3. Label and disconnect hydraulic hoses from hydraulic manifold. Install caps or plugs in hoses to prevent contamination and leakage of hydraulic oil. Install plugs in manifold ports.

4. Remove manifold from vehicle using Figure 41 as a guide.

Installation (Fig. 41)

1. Install manifold to vehicle using Figure 41 as a guide.
2. Replace o-rings on hydraulic hoses and fittings. Remove caps and plugs from hoses and fittings. Connect hydraulic hoses to manifold.
3. Check oil level in reservoir (see High Flow Hydraulic Kit Installation Instructions). Add correct oil if necessary.

Valve Cartridge Service (Fig. 42)

1. Make sure the entire outer surface of the manifold is clean before removing the valve.
2. For solenoid cartridge valve, remove nut securing solenoid to the cartridge valve. Carefully slide solenoid off the valve. Locate and retrieve seals from top and bottom of coil.

IMPORTANT: Use care when handling the valve cartridge. Slight bending or distortion of the stem tube can cause binding and malfunction.

3. Remove cartridge valve with a deep socket wrench. Note correct location for o-rings, sealing rings, and backup rings. Remove and discard seal kit.

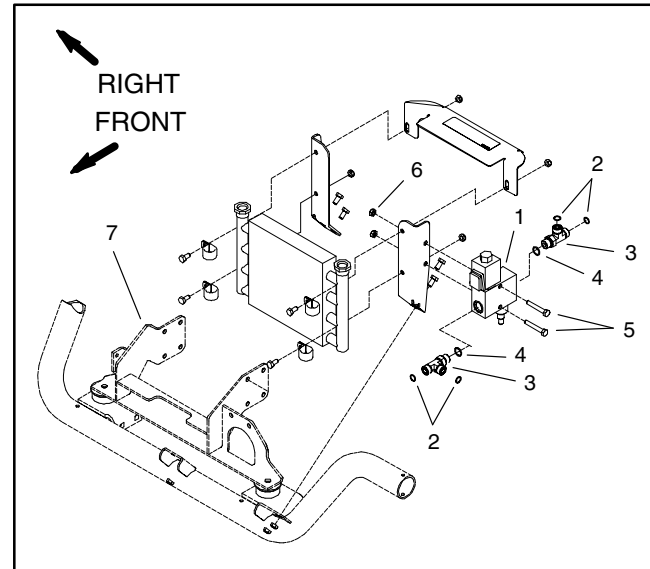


Figure 41

- | | |
|-----------------------|-------------------------|
| 1. Hydraulic manifold | 5. Cap screw |
| 2. O-ring | 6. Lock nut (2 used) |
| 3. Hydraulic fitting | 7. Engine mount bracket |
| 4. O-ring | |

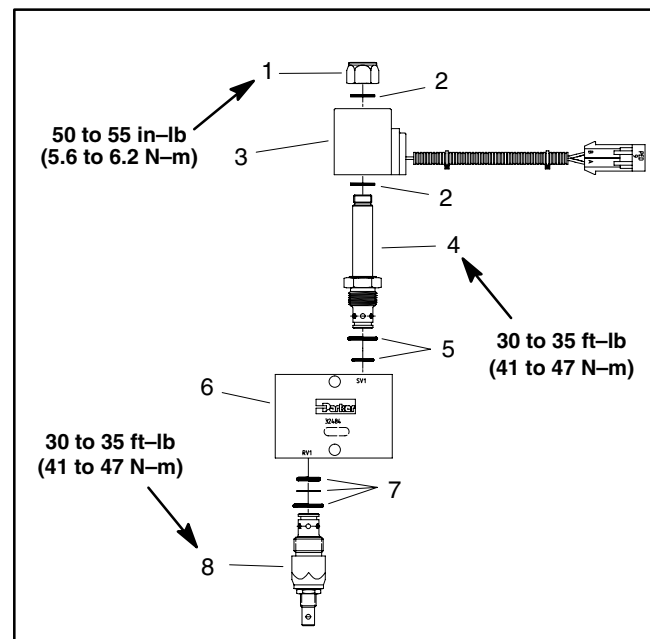


Figure 42

- | | |
|-----------------------------|---------------------------|
| 1. Retaining nut | 5. Seal kit |
| 2. Solenoid seal | 6. Manifold body |
| 3. Solenoid coil | 7. Seal kit |
| 4. Solenoid cartridge valve | 8. Relief valve cartridge |

4. Visually inspect the port in the manifold for damage to the sealing surfaces, damaged threads, and contamination.

5. Visually inspect cartridge valve for damaged sealing surfaces and contamination.

A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing malfunction.

B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.



6. Clean cartridge valve using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful not to damage cartridge. Use compressed air for cleaning.

7. Reinstall the cartridge valve:

A. Lubricate new seal kit components with clean hydraulic oil and install on valve. The o-rings, sealing rings, and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

IMPORTANT: Use care when handling the valve cartridge. Slight bending or distortion of the stem tube can cause binding and malfunction.

B. Thread cartridge valve carefully into manifold port. The valve should go in easily without binding.

C. Using a deep socket, torque cartridge valve from 30 to 35 ft-lb (41 to 47 N-m).

D. For solenoid valve, carefully install solenoid coil to the cartridge valve making sure that seal is installed on both top and bottom of coil. Torque nut from 50 to 55 in-lb (5.6 to 6.2 N-m). Over-tightening may damage the solenoid or cause the valve to malfunction.

8. If problems still exist, remove valve and clean again or replace valve.

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Front Wheel Drive (4WD)

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Specifications

Item	Description
Front Differential	5.0 to 1 ratio, single reduction
Front Brakes	Hydraulically operated, self adjusting, 8-inch diameter drum
Bidirectional Clutch	Overrunning type

General Information

The “Automatic on Demand” four wheel drive feature, on this vehicle, does not require operator activation. The front wheel drive is not engaged (no power delivered to front wheels) until the rear wheels begin to lose traction. The bidirectional clutch senses the rear wheels slipping, engages the front wheel drive, and delivers power to the front wheels. The four wheel drive system continues to deliver power to the front wheels until the rear wheels

have enough traction to move the vehicle without slipping. Once this occurs, the system stops delivering power to the front wheels and the handling characteristics become similar to that of a two wheel drive vehicle. The four wheel drive system functions in both forward and reverse. When front wheels are turned, the rear wheels will slip slightly more before power is delivered to the front wheels.

Service and Repairs

Front Wheel and Axle Housing Assembly

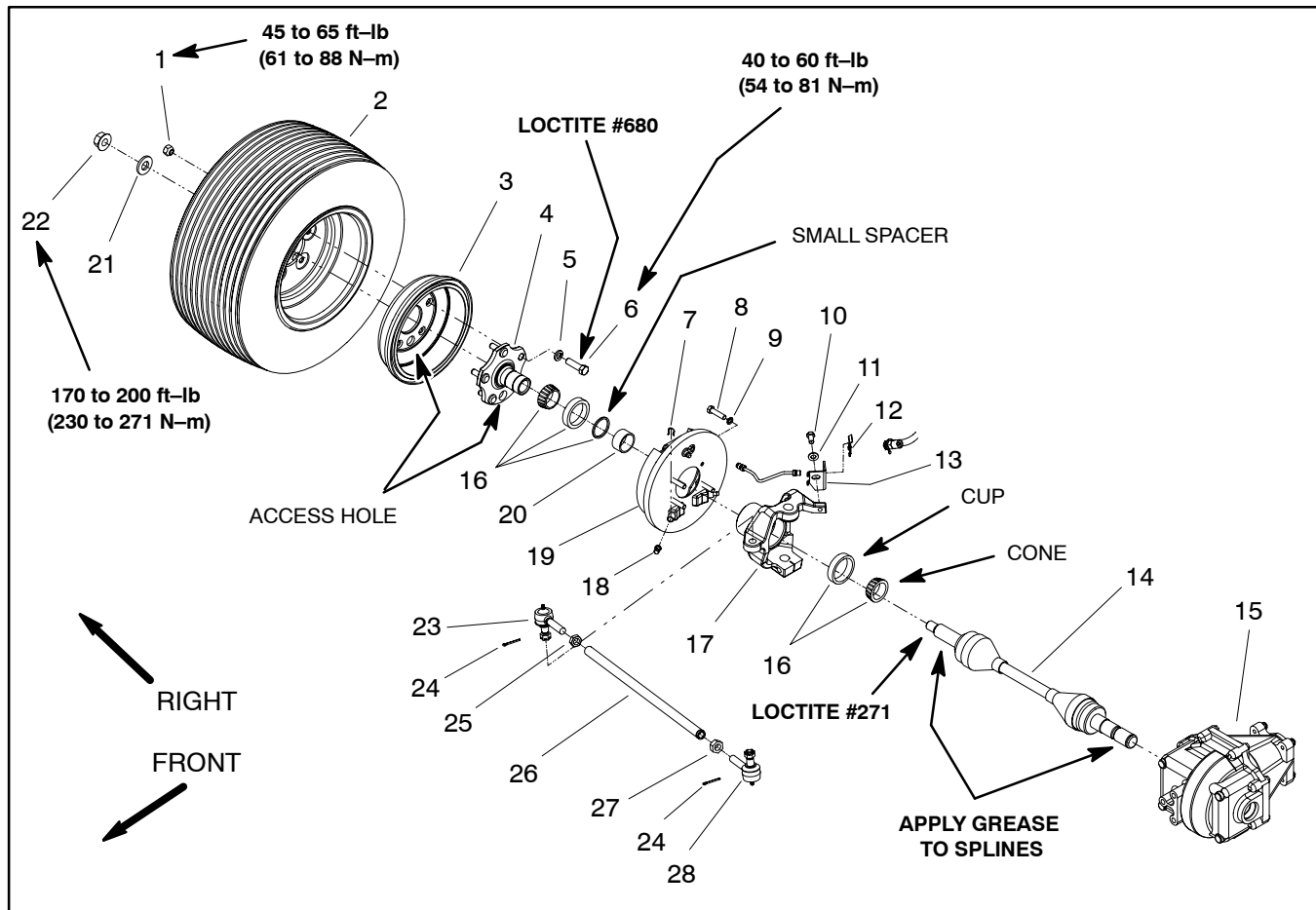


Figure 1

- | | | |
|-----------------------------------|---|-----------------------------|
| 1. Wheel nut (5 used per wheel) | 11. Flat washer | 20. Wheel bearing spacer |
| 2. Wheel and tire assembly | 12. Brake hose retainer clip | 21. Hardened washer |
| 3. Brake drum | 13. Brake hose bracket | 22. Hex flange nut |
| 4. Stub axle | 14. Constant velocity (CV) joint assembly | 23. Tie rod end (RH thread) |
| 5. Lock washer | 15. Differential | 24. Cotter pin |
| 6. Hex bolt (5 used per wheel) | 16. Bearing assembly | 25. Jam nut (RH thread) |
| 7. Brake cable clip | 17. Axle housing (RH shown) | 26. Tie rod |
| 8. Cap screw (4 used per brake) | 18. Brake plate plug | 27. Jam nut (LH thread) |
| 9. Lock washer (4 used per brake) | 19. Front brake assembly (RH shown) | 28. Tie rod end (LH thread) |
| 10. Cap screw | | |

Disassembly (Fig. 1)

1. Park vehicle on a level surface. Make sure engine is off. Engage parking brake and block rear wheels.

2. Partially loosen front wheel nuts. Jack up and secure front wheel off the ground (see Jacking Instructions in Operator's Manual). Remove wheel nuts and wheel from the vehicle.

NOTE: If the brake drum sticks to the brake shoes during removal, loosen brake shoes from the drum by turning bolt adjuster through access hole in brake drum.

3. Remove brake drum from the stub axle.

4. Remove hex flange nut (22) and hardened washer (21) from the threaded shaft of the CV joint (14). Discard nut.

5. Pull stub axle (4) and outer bearing cone from the axle housing.

6. Remove cap screw and flat washer securing the brake hose bracket (13) to the axle housing.

7. Remove four cap screws and lock washers securing the brake assembly (19) to the axle housing. Position brake assembly away from the housing.

8. Remove cotter pin and slotted hex nut from the tie rod end assembly. Separate tie rod end from the axle housing.

9. Remove axle housing as follows (Fig. 2):

A. Remove cotter pin and slotted hex nut from the upper ball joint. Separate upper ball joint from the axle housing.

B. Remove cap screw (6) and lock nut (5) from axle housing.

C. Remove cotter pin and slotted hex nut from the lower ball joint. Separate lower ball joint from the axle housing. Remove axle housing from the CV joint.

D. Remove remaining inner bearing cone.

Inspection (Fig. 1)

IMPORTANT: If any part of a bearing assembly (16) needs replacement, replace bearings as a matched set.

1. If any foreign material is in the bearing, clean bearing and determine source of the material. Replace bearings (16) if any of the following conditions occur (Fig. 3):

A. Spalling or pitting on roller or cone contact surfaces. Corrosion that can not be cleaned up with light polishing.

B. The rib face on the cone is worn back or roller ends are worn or scored. The roller cage is cracked or broken.

C. Peeling, gouges or nicks inside the cup or on rollers. Scalping, high spots, brinelling or burrs in the cups.

D. The seal attached to the bearing cone is cracked, torn or damaged.

2. If ball joint seals are torn or cracked, replace seals and lubricate ball joints.

3. Replace worn or cross-threaded wheel studs or wheel nuts.

4. Replace wheel bearing spacer (20) if worn or damaged.

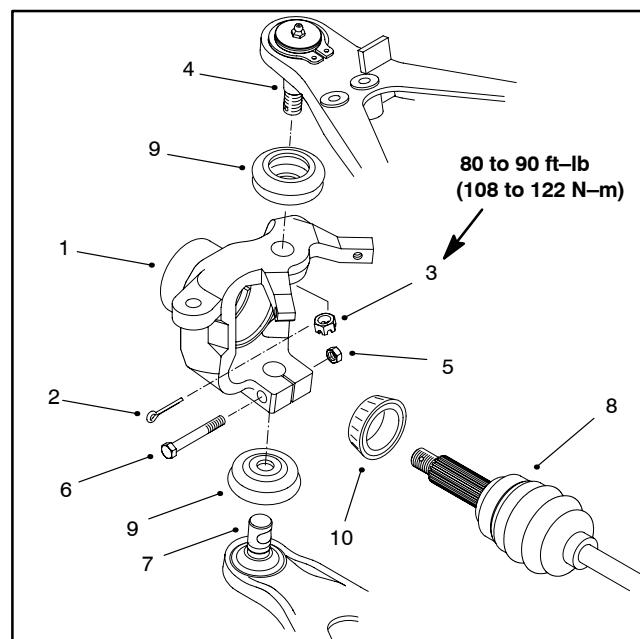


Figure 2

- | | |
|---------------------|------------------------|
| 1. Axle housing | 6. Cap screw |
| 2. Cotter pin | 7. Lower ball joint |
| 3. Slotted hex nut | 8. CV joint |
| 4. Upper ball joint | 9. Ball joint seal |
| 5. Lock nut | 10. Inner bearing cone |

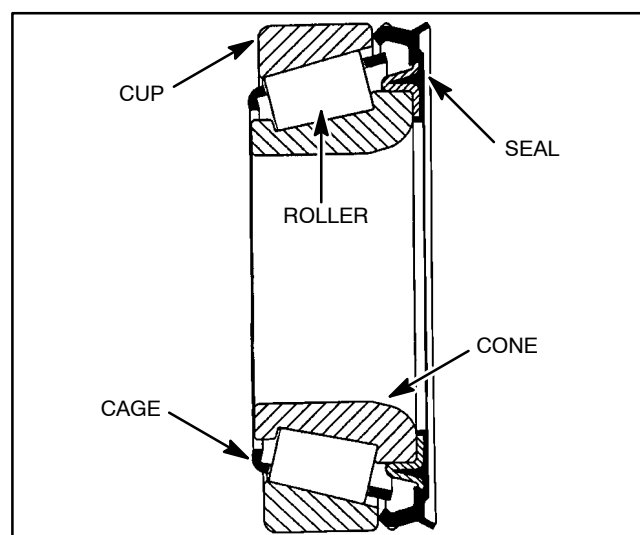


Figure 3

Assembly (Fig. 1)

1. If hex bolts and lock washers were removed from the stub axle:

A. Thoroughly clean threads of hex bolt and stub axle. Apply Loctite #680 (or equivalent) to threads of hex bolt closest to bolt head.

B. Install hex bolt with lock washer into stub axle. Torque bolt from 40 to 60 ft-lb (54 to 81 N-m).

IMPORTANT: Bearing cones and bearing cups are part of a matched bearing set; these parts are not interchangeable. Use one matched bearing set per axle housing.

2. If a bearing cup was removed from the axle housing, press **new** bearing cup(s) into each end of the axle housing.
3. Pack both bearing cones with Mobile high temperature grease or equivalent. If the outer bearing cone was removed from the stub axle, slide wide end of **new** bearing cone onto the shaft of the stub axle and press cone onto the shaft (Fig. 4).
4. Position front brake assembly (19) to the axle housing. Secure brake assembly to the axle housing with four cap screws (8) and lock washers (9).
5. Insert shaft of the stub axle into the axle housing. Slide small spacer onto the shaft, then slide wheel bearing spacer onto the shaft.
6. Slide inner bearing cone, with its narrow end first, onto the shaft of the stub axle.
7. Apply No. 2 general purpose grease to the splines of the CV joint.
8. Position stub axle/axle housing assembly to the CV joint. Insert splined end of the CV joint into the stub axle.
9. Install axle housing as follows (Fig. 2):

IMPORTANT: Make sure cotter pin has a 0.002 inch (0.05 mm) clearance from the CV joint boot.

- A. Connect lower ball joint to the axle housing. Install slotted hex nut and torque from 80 to 90 ft-lb (108 to 122 N-m). If necessary to install cotter pin, tighten nut further and secure assembly with cotter pin.
- B. Install cap screw into axle housing and secure with lock nut.
- C. Connect upper ball joint to the axle housing. Install slotted hex nut and torque from 80 to 90 ft-lb (108 to 122 N-m). If necessary to install cotter pin, tighten nut further and secure assembly with cotter pin.

10. Connect tie rod end to the axle housing with slotted hex nut. Torque slotted hex nut from 45 to 55 ft-lb (61 to 74 N-m). If necessary to install cotter pin, tighten nut further and secure assembly with cotter pin..

IMPORTANT: Hex flange nut (22) should be replaced whenever it is removed.

11. Apply Loctite #271 (or equivalent) to the threads of the CV joint. Install hardened washer (21) and hex flange nut (22) to the CV joint threads. Torque flange nut from 170 to 200 ft-lb (230 to 271 N-m).

12. Secure brake hose bracket (13) to the axle housing with cap screw and flat washer.

NOTE: Make sure access hole on both the brake drum and stub axle align when installed.

13. Install brake drum to stub axle.

14. Adjust brake shoes:

- A. Align access hole in brake drum with adjuster bolt on adjuster assembly.
- B. Rotate adjusting bolt to increase adjuster length until brake shoes contact brake drum.
- C. Back off adjuster until drum rotates freely.

15. Secure wheel to the brake drum with five wheel nuts. Lower front wheel to the ground. Torque wheel nuts from 45 to 65 ft-lb (61 to 88 N-m).

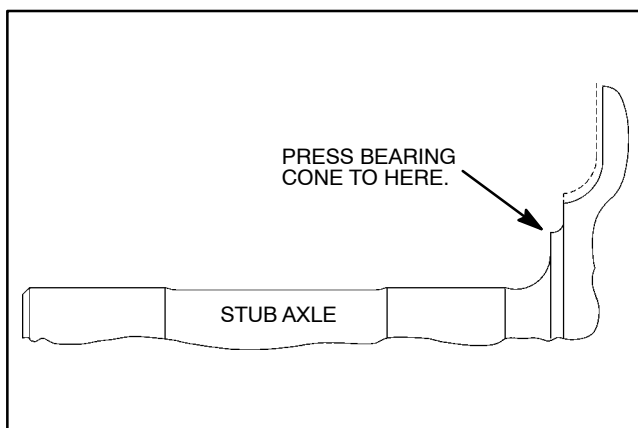


Figure 4

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Front Brake

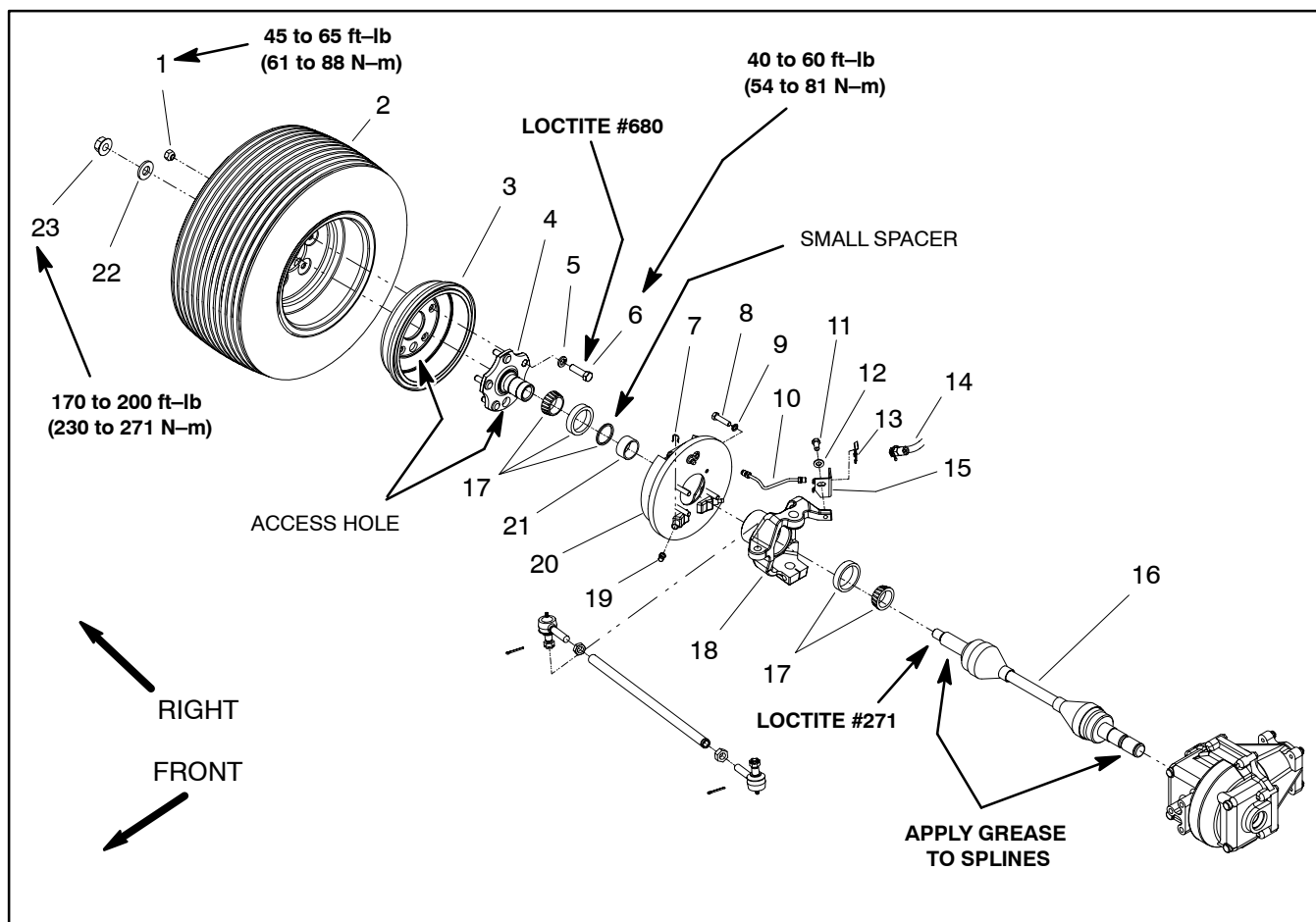


Figure 5

- | | | |
|-----------------------------------|---|-------------------------------------|
| 1. Wheel nut (5 used per wheel) | 9. Lock washer (4 used per brake) | 17. Bearing assembly |
| 2. Wheel and tire assembly | 10. Brake tube | 18. Axle housing (RH shown) |
| 3. Brake drum | 11. Cap screw | 19. Brake plate plug |
| 4. Stub axle | 12. Flat washer | 20. Front brake assembly (RH shown) |
| 5. Lock washer (5 used per wheel) | 13. Brake hose retainer clip | 21. Wheel bearing spacer |
| 6. Hex bolt (5 used per wheel) | 14. Brake hose | 22. Hardened washer |
| 7. Brake cable clip | 15. Brake hose bracket | 23. Hex flange nut |
| 8. Cap screw (4 used per brake) | 16. Constant velocity (CV) joint assembly | |

Removal (Fig. 5)

1. Park vehicle on a level surface. Make sure engine is off. Engage parking brake and block rear wheels.

2. Partially loosen front wheel lug nuts. Jack up and secure front wheel off the ground (see Jacking Instructions in Operator's Manual). Remove wheel nuts and wheel from the brake drum.

NOTE: If the brake drum sticks to the brake shoes during removal, loosen brake shoes from the drum by turning bolt adjuster through access hole in brake drum.

3. Remove brake drum from hub.

4. Remove hex flange nut (23) and hardened washer (22) from the threaded shaft of the CV joint. Discard nut.

5. Pull stub axle and outer bearing cone from the axle housing and the splined end of the CV joint. Make sure wheel bearing spacer and small spacer come out with the stub axle.

NOTE: It may be necessary to remove the brake assembly from the axle housing for servicing some components such as the brake cylinder assembly.

6. If necessary, remove brake assembly as follows:

A. Disconnect brake tube (10) from the brake assembly. Plug brake tube to prevent contaminants from entering brake system.

B. Remove brake assembly from the axle housing by removing the four cap screws (8) and lock washers (9) from the housing.

Installation (Fig. 5)

1. If the brake assembly was removed from the axle housing, install brake assembly as follows:

- A. Secure brake assembly to the axle housing with four cap screws and lock washers.

IMPORTANT: Make sure brake hose connections are clean and free of dirt.

- B. Remove plug from front brake hose. Connect brake tube to brake assembly.

2. If hex bolts and lock washers were removed from the stub axle:

- A. Thoroughly clean threads of hex bolt and stub axle. Apply Loctite #680 (or equivalent) to threads of hex bolt closest to bolt head.

- B. Install hex bolt with lock washer into stub axle. Torque bolt from 40 to 60 ft-lb (54 to 81 N-m).

3. Insert small spacer and then wheel bearing spacer onto the stub axle. Make sure bearing cones are sufficiently greased.

4. Apply No. 2 general purpose grease to the splines of the CV joint.

5. Insert stub axle with outer bearing cone and spacers into the axle housing and onto the splined end of the CV joint.

IMPORTANT: Hex flange nut (23) should be replaced whenever it is removed.

6. Apply Loctite #271 (or equivalent) to the threads of the CV joint. Install hardened washer and new hex flange nut to the CV joint threads. Torque flange nut from 170 to 200 ft-lb (230 to 271 N-m).

NOTE: Make sure access hole on both the brake drum and stub axle align when installed.

7. Install brake drum to stub axle.

8. Adjust brake shoes as follows:

- A. Align access hole in the brake drum with the bolt adjuster.
- B. Rotate bolt adjuster so adjuster assembly length makes both brake shoes contact the brake drum.
- C. Back off bolt adjuster until drum rotates freely.

9. Bleed front brakes (see Bleeding the Brakes in the Service and Repairs section of Chapter 7 – Chassis).

10. Secure front wheel to the brake drum with five lug nuts. Lower front wheel to the ground. Torque lug nuts from 45 to 65 ft-lb (61 to 88 N-m).

Front Brake Service

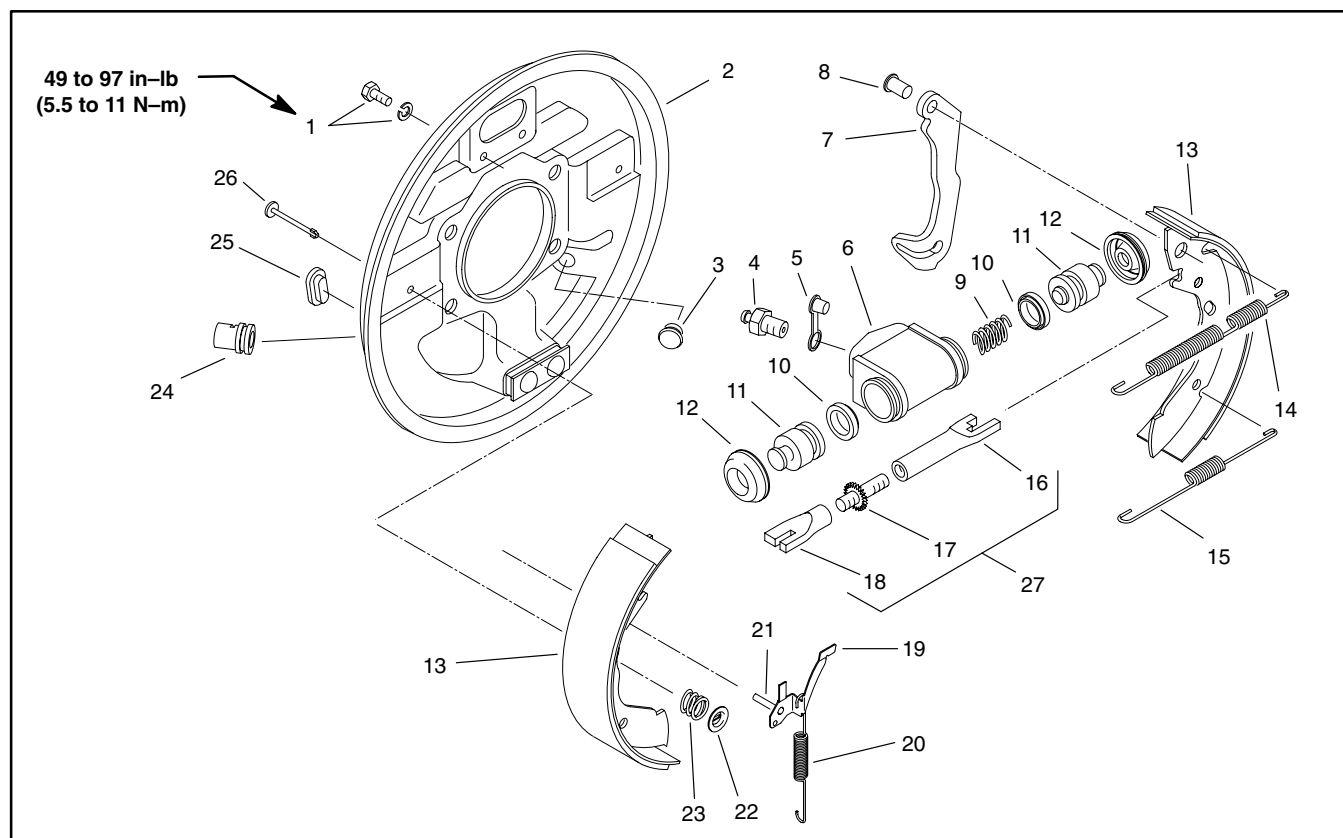


Figure 6

- | | | |
|---------------------------------------|-----------------------|-------------------------------|
| 1. Cap screw and lock washer (2 used) | 10. L-type seal | 19. Pawl |
| 2. Back plate | 11. Piston | 20. Adjuster spring |
| 3. Plug | 12. Dust cover | 21. Pawl pin |
| 4. Bleed screw | 13. Brake shoe | 22. Hold down washer (2 used) |
| 5. Bleed screw cap | 14. Upper shoe spring | 23. Hold down spring (2 used) |
| 6. Brake cylinder body | 15. Lower shoe spring | 24. Pipe guide |
| 7. Parking brake lever | 16. Female push rod | 25. Inspection plug |
| 8. Pin | 17. Bolt adjuster | 26. Hold down pin (2 used) |
| 9. Spring | 18. Adjuster sleeve | 27. Adjuster assembly |

For brake service procedures, refer to Brake Service in the Service and Repairs section of Chapter 7 – Chassis.

Inspect Constant Velocity (CV) Joint Boot and Test CV Joint

Inspect CV Joint Boot

Inspect CV joint boot after every 200 hours of operation. A torn boot is the most common cause of CV joint failures.

NOTE: A worn and noisy CV joint with the boot in good condition and filled with grease is not uncommon. Potholes, curb contact, or collision damage can chip bearing components and initiate worn conditions.

1. Look for grease on the suspension, inner tire sidewall, or fender to indicate a possible torn boot. Inspect boot for cracks, holes, tears, or loose clamps. Dirty grease within the boot may indicate damage to the CV joint.

2. If the boot is cracked or torn, or has any holes or loose clamps, remove CV joint (see Constant Velocity Joint in this section) and replace boot.

Test CV Joint

1. Test drive vehicle on a smooth surface to verify CV joint problem.

2. Accelerate or back-up vehicle slowly with the front wheels turned. Listen for snapping or clicking noise at the wheel, then drive straight ahead.

A. If the noise remains constant, the wheel bearing is the likely problem (see Front Wheel and Axle Housing Assembly in this section).

B. If the noise gets louder when turning, the outboard CV joint is likely worn. A badly worn joint will snap or click when driving straight ahead, however the noise will increase when accelerating or backing up into a turn.

3. Accelerate vehicle quickly and straight ahead. Vibration or shudder indicates a worn or sticking inboard CV joint.

4. Accelerate vehicle at an angle over a ramp or up a hill. A clunking noise indicates a worn inboard CV joint.

5. If any CV joint components are worn or damaged, the CV joint assembly must be replaced.

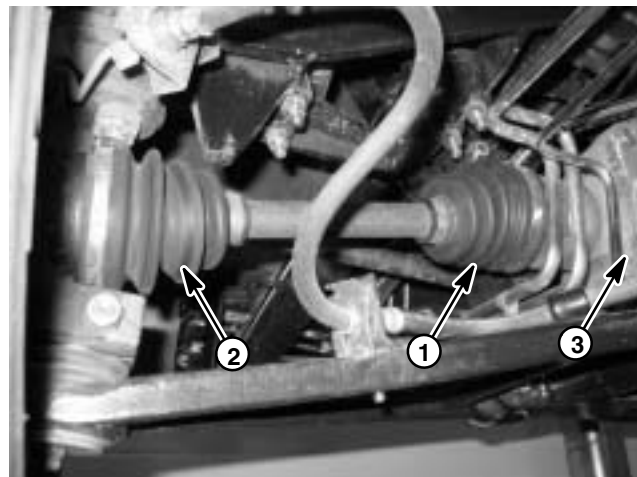


Figure 7

1. Inboard boot
2. Outboard boot

3. Differential

Constant Velocity (CV) Joint

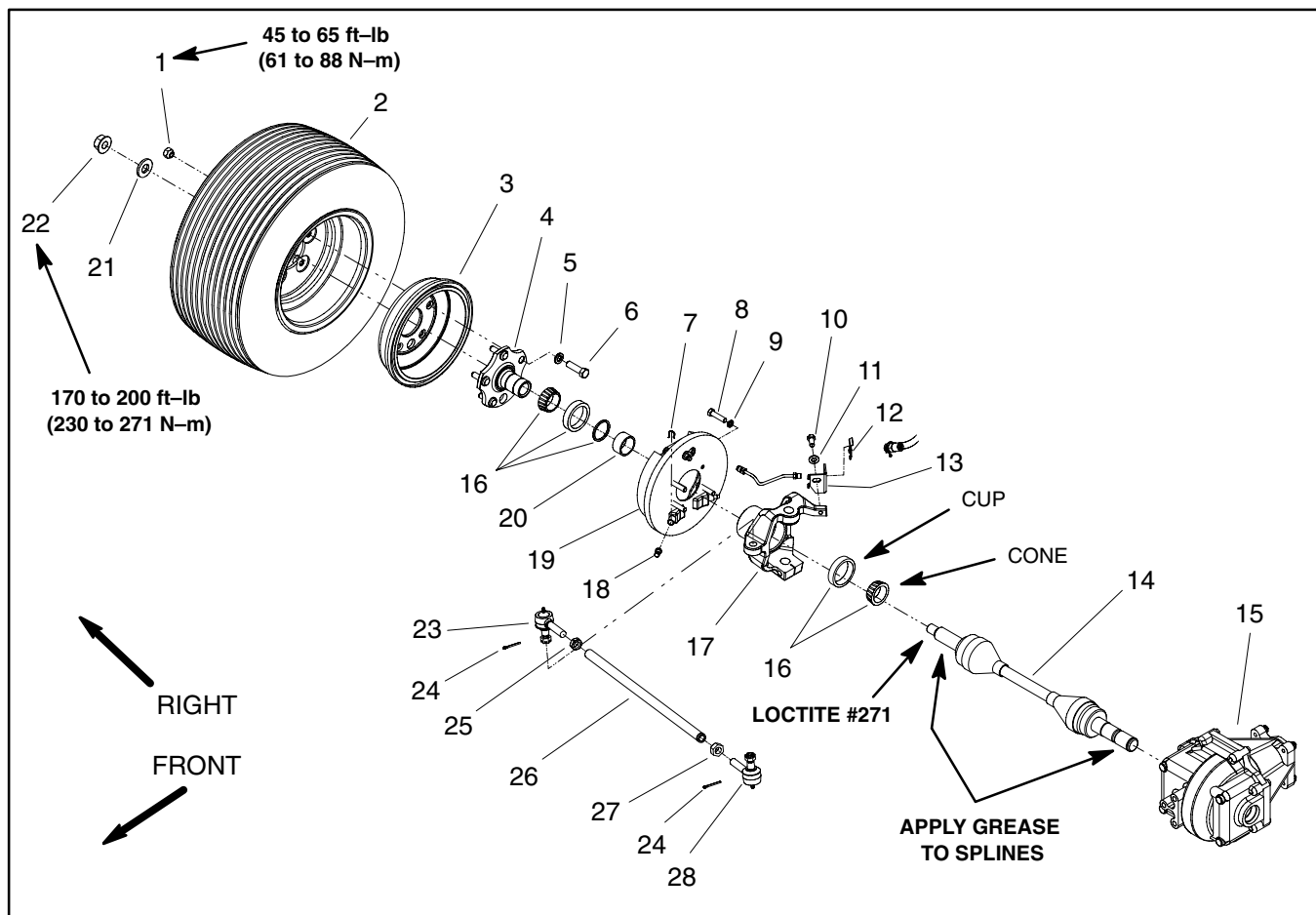


Figure 8

- | | | |
|-----------------------------------|---|-----------------------------|
| 1. Wheel nut (5 used per wheel) | 11. Flat washer | 20. Wheel bearing spacer |
| 2. Wheel and tire assembly | 12. Brake hose retainer clip | 21. Hardened washer |
| 3. Brake drum | 13. Brake hose bracket | 22. Hex flange nut |
| 4. Stub axle | 14. Constant velocity (CV) joint assembly | 23. Tie rod end (RH thread) |
| 5. Lock washer (5 used per wheel) | 15. Differential | 24. Cotter pin |
| 6. Hex bolt (5 used per wheel) | 16. Bearing assembly | 25. Jam nut (RH thread) |
| 7. Brake cable clip | 17. Axle housing (RH shown) | 26. Tie rod |
| 8. Cap screw (4 used per brake) | 18. Brake plate plug | 27. Jam nut (LH thread) |
| 9. Lock washer (4 used per brake) | 19. Front brake assembly (RH shown) | 28. Tie rod end (LH thread) |
| 10. Cap screw | | |

Removal (Fig. 8)

1. Remove wheel, stub axle and axle housing from the CV joint and front suspension (see Front Wheel And Axle Housing Assembly in this section).

IMPORTANT: Make sure not to damage the oil seal on the front differential with the pry bars when removing the CV joints.

2. Use two small pry bars (180° apart) to leverage the CV joint out of the front differential. Use even pressure on both pry bars (Fig. 9).

IMPORTANT: With damaged CV joints, there is the possibility that the wheel bearings may be damaged as well. It is recommended that the wheel bearings be inspected when CV joints are replaced.

3. Inspect front wheel bearings (see Inspection in Front Wheel And Axle Housing Assembly in this section).

Installation (Fig. 8)

1. If necessary, install a new circular clip onto the splined (inboard) end of the CV joint.

2. Grease splines of CV joint with No. 2 general purpose lithium base grease.

3. Insert end of CV joint into the front differential until a snap is heard. **Pull outward on CV joint as close as possible to the front differential to make sure that the CV joint is properly snapped into place.**

4. Reassemble axle housing, stub axle, and wheel to the CV joint and front suspension (see Front Wheel And Axle Housing Assembly in this section).

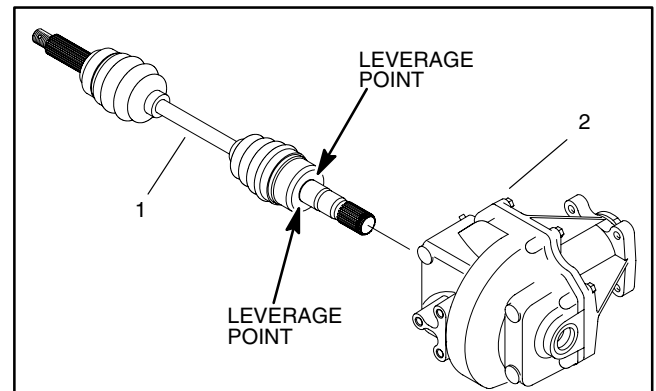


Figure 9

1. CV joint

2. Front differential

Front Differential

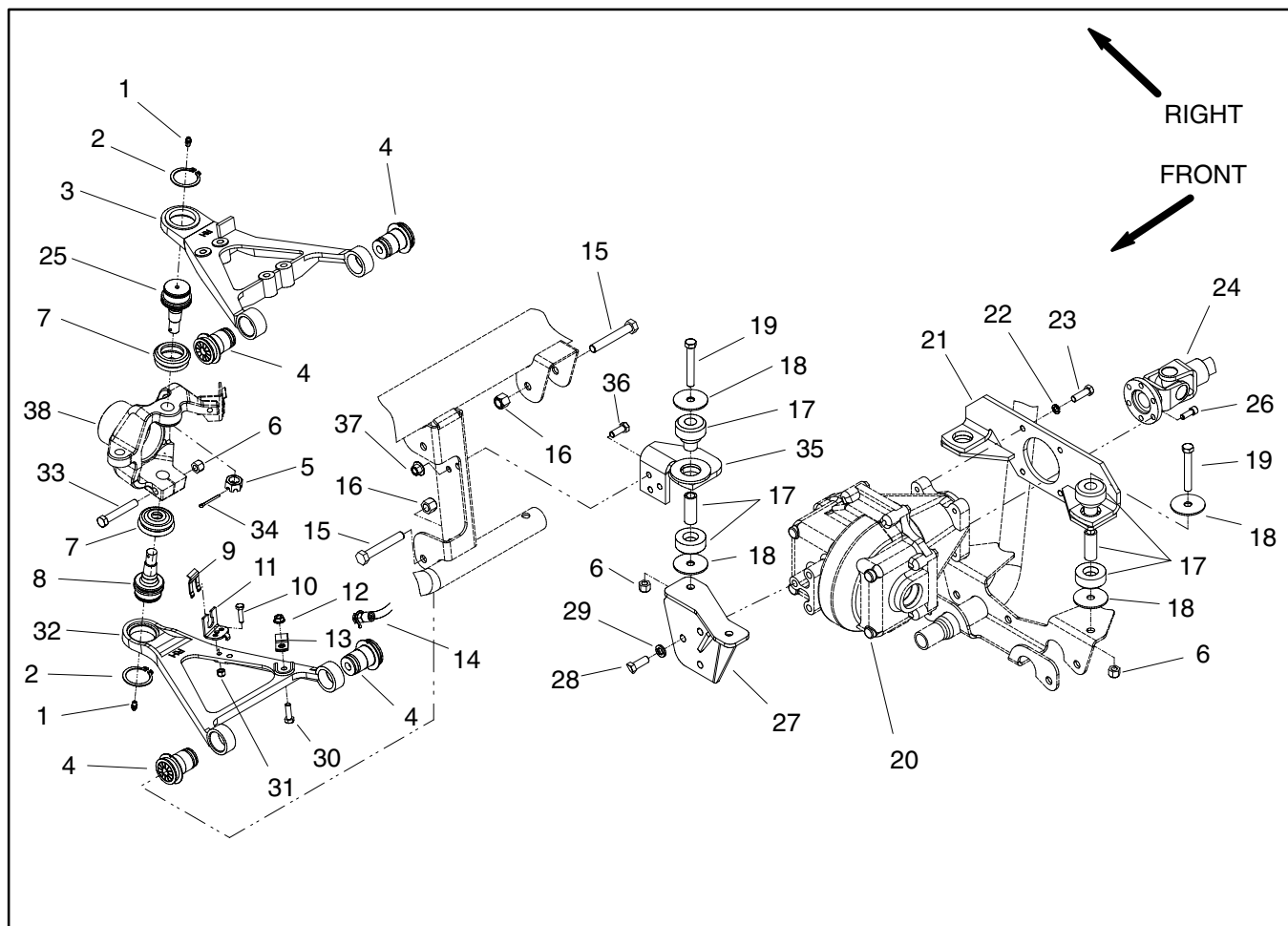


Figure 10

- | | | |
|------------------------|--|-------------------------------------|
| 1. Grease fitting | 14. Front brake hose | 27. Differential front bracket |
| 2. Retaining ring | 15. Cap screw (2 used per control arm) | 28. Cap screw (3 used) |
| 3. Upper control arm | 16. Lock nut (2 used per control arm) | 29. Lock washer (3 used) |
| 4. Flange bushing | 17. Mount assembly (4 used) | 30. Cap screw |
| 5. Slotted hex nut | 18. Snubbing washer (8 used) | 31. Lock nut |
| 6. Lock nut | 19. Cap screw (4 used) | 32. Lower control arm |
| 7. Ball joint seal | 20. Front differential | 33. Cap screw |
| 8. Lower ball joint | 21. Differential rear mount | 34. Cotter pin |
| 9. Brake hose retainer | 22. Lock washer (4 used) | 35. Support bracket (RH shown) |
| 10. Cap screw | 23. Cap screw (4 used) | 36. Cap screw (3 used per bracket) |
| 11. Brake hose bracket | 24. Differential drive shaft | 37. Flange nut (3 used per bracket) |
| 12. Lock nut | 25. Upper ball joint | 38. Axle housing (RH shown) |
| 13. R-clamp | 26. Socket hex head screw (6 used) | |

Removal (Fig. 10)

1. Park vehicle on a level surface. Make sure engine is off. Set parking brake and block rear wheels.
2. Drain front differential oil into a suitable container by removing the drain plug from its bottom. Install drain plug when draining is complete.
3. Remove both CV inboard joint assemblies from the front differential (see Constant Velocity (CV) Joint Assembly Removal).
4. Remove differential drive shaft from the front differential flange (see Differential Drive Shaft Removal).
5. Remove front brake lines and clamps that might interfere with the removal of the front differential. Tie any cables out of the way that might interfere with removal.



6. Remove four cap screws (23) and lock washers (22) securing the front differential to the differential rear mount (21).
7. Remove differential rear mount (21) from frame by removing both lock nuts (6) and cap screws (19). Locate and remove mount assemblies (17) and snubbing washers (18).
8. Remove three cap screws (28) and lock washers (29) from the differential front bracket (27) and front differential.
9. Pull front differential from the vehicle.

Installation (Fig. 10)

1. Secure front differential to the differential front bracket with three cap screws (28) and lock washers (29).
2. Secure differential rear mount (21) to frame with cap screws (19), snubbing washers (18), mount assemblies (17), and lock nuts (6).
3. Secure front differential to differential rear mount with four cap screws (23) and lock washers (22).
4. Reconnect front brake lines and clamps. Reposition cables.
5. Reinstall differential drive shaft to the front differential flange (see Differential Drive Shaft Installation).
6. Reinstall both CV joints to the front differential (see Constant Velocity (CV) Joint Assembly Installation).
7. Make sure front differential drain plug is installed properly. Fill front differential with oil (see Operator's Manual).
8. Bleed front brakes (see Bleeding the Brakes in Service and Repairs section of Chapter 7 – Chassis).

Front Differential Service

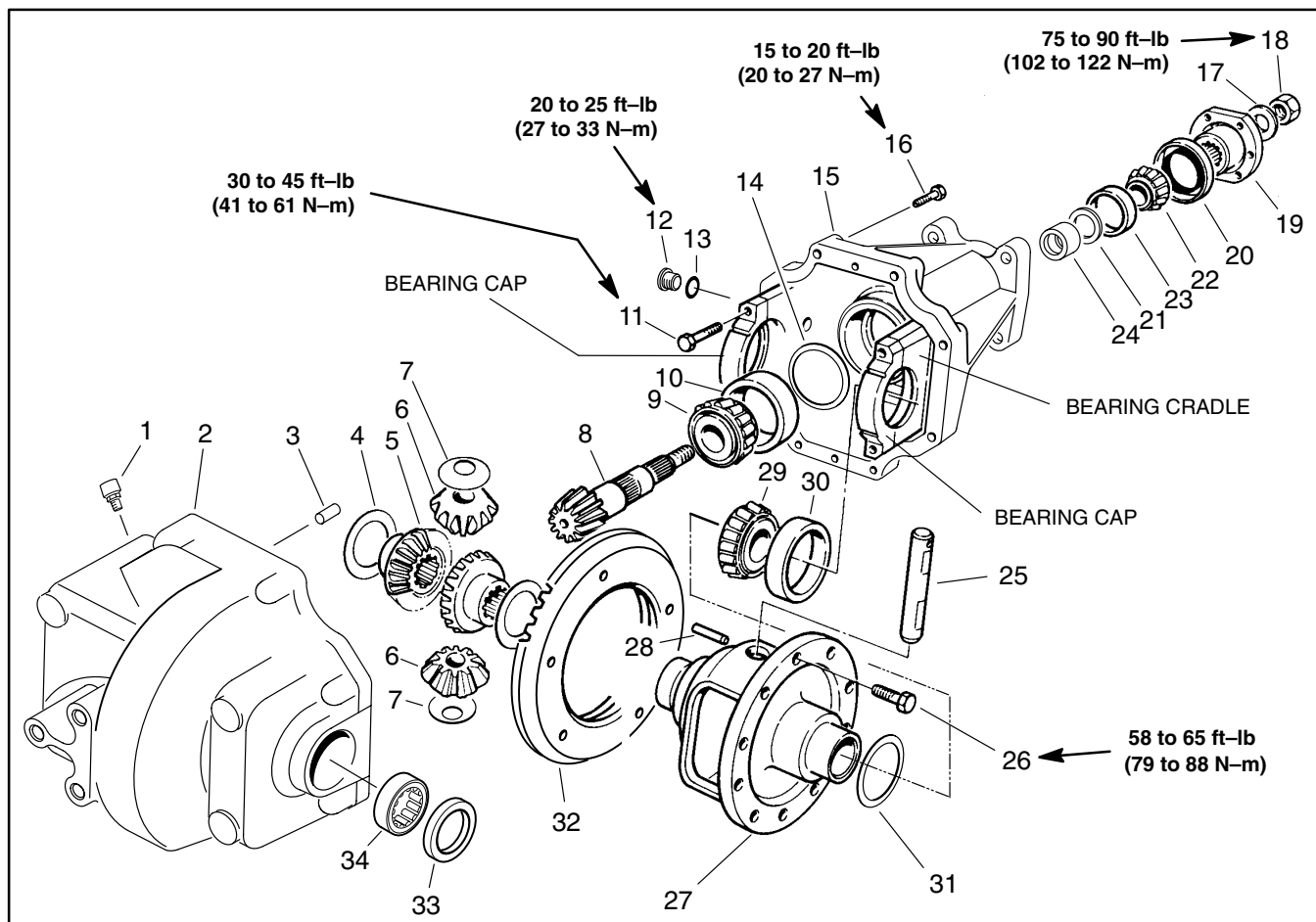


Figure 11

- | | | |
|---------------------------|--------------------------|-----------------------------|
| 1. Vent | 13. O-ring seal (2 used) | 24. Bearing spacer |
| 2. Front housing | 14. Shim | 25. Pinion shaft |
| 3. Alignment pin (2 used) | 15. Carrier assembly | 26. Cap screw (5 used) |
| 4. Thrust washer | 16. Cap screw (8 used) | 27. Differential case |
| 5. Side bevel gear | 17. Washer | 28. Roll pin |
| 6. Pinion gear | 18. Lock nut | 29. Bearing cone (2 used) |
| 7. Thrust washer | 19. Coupler flange | 30. Bearing cup (2 used) |
| 8. Pinion gear | 20. Oil seal | 31. Shim |
| 9. Bearing cone | 21. Shim | 32. Ring gear |
| 10. Bearing cup | 22. Bearing cone | 33. Oil seal (2 used) |
| 11. Cap screw (4 used) | 23. Bearing cup | 34. Needle bearing (2 used) |
| 12. Plug (2 used) | | |

Disassembly (Fig. 11)

1. Remove flange (19) from the pinion shaft (8) by removing lock nut (18) and washer (17) from the threaded end of the shaft. Use a bearing puller if necessary to remove the coupler flange (Fig. 12).

2. Secure carrier assembly (15) so that pinion gear shaft (8) is facing up. Remove eight cap screws (16) securing the front housing to the carrier assembly.

3. Separate front housing (2) from the carrier assembly (15) using a cold chisel to initially separate the two parts. Use a putty knife to further separate the housing and carrier assembly (Fig. 13).

IMPORTANT: The bearing caps are marked for reassembly. Place caps in a safe place to avoid damaging their machined surface. Place caps back in the same position during reassembly.

4. Remove four cap screws (11) and both bearing caps from the bearing cradles (Fig. 14).

IMPORTANT: Keep mating bearing bearing cups (30) with matching bearing cups (30) and bearing caps.

5. Remove differential gears from the carrier assembly by using two wooden handles under the differential case (27) to pry up the case and gears (Fig. 15).



Figure 12



Figure 13



Figure 14



Figure 15

IMPORTANT: When using a hammer and punch to remove the roll pin (28) and pinion shaft (25), be careful not to damage any gear teeth.

6. Drive roll pin (28) from the pinion shaft (25) using a long thin drift punch (Fig. 16).

7. Support differential case (27) in a vise. Drive pinion shaft (25) from the differential case using a long drift punch (Fig. 17).

8. Remove both sets of pinion gear shafts (5 and 6) and thrust washers (4 and 7) by rotating the gears 90° through the opening in the differential case (27) (Fig. 18).

IMPORTANT: Avoid damaging gear teeth when removing the gear ring (32) from the differential case (27).

9. Remove five cap screws (26) from the differential case (27) and gear ring (32). Drive ring gear off the differential case using a hard wood block and a hammer (Fig. 19).



Figure 16



Figure 17



Figure 18



Figure 19

NOTE: Remove bearing cones (29) from the differential case **only** if they need replacing (see Inspection). Retain shims (31) for reassembly of new bearing cones.

10. Remove bearing cone (29) from the differential case (27) with a puller. **Make sure puller is inserted into the indentations on the differential case (Fig. 20).**

IMPORTANT: Make sure shims (21) are kept after they are removed from the carrier assembly (15).

11. Pull pinion gear shaft (8) and bearing cone (9) from the carrier assembly (15). If necessary, press pinion gear shaft out of the carrier housing. Remove oil seal (20) and discard it. Remove bearing cone (22), shims (21), and spacer (24) from the carrier housing (15) (Fig. 21).

NOTE: Remove bearing cone (9) from the pinion gear shaft (8) **only** if it needs replacing (see Inspection).

12. Press pinion gear shaft (8) out of the bearing cone (9) using bearing press. **Make sure shaft does not drop to the floor (Fig. 22).**

NOTE: Remove bearing cup (23) from the carrier housing (15) **only** if it needs replacing (see Inspection).

13. Press bearing cup (23) from the carrier assembly (15) (Fig. 23).



Figure 20



Figure 21



Figure 22



Figure 23

IMPORTANT: Make sure shims (14) are kept after they are removed from the carrier assembly (15).

NOTE: Remove bearing cup (10) from the carrier housing (15) **only** if it needs replacing (see Inspection).

14. Pull bearing cup (10) and shims (14) from the carrier assembly (15) (Fig. 24).

NOTE: Remove needle bearing (34) from the front housing (2) **only** if it needs replacing (see Inspection).

15. Remove oil seal (33). Press needle bearing (34) from the front housing (2) (Fig. 25).

Inspection (Fig. 11)

1. Inspect front housing (2) and carrier assembly (15) for cracks and damage. Replace either part if its condition could affect the operation of the front differential assembly. Clean flange surfaces of any sealant, oil, and dirt (Fig. 26).

2. Inspect needle bearings (34) for wear and damage. Replace bearings if needles are bent, do not rotate freely, or do not remain in the bearing cage. Replace oil seal (33) if it is cracked, nicked, torn, or distorted such that it would not hold a proper seal (Fig. 27).



Figure 24



Figure 25



Figure 26



Figure 27

3. Inspect differential case (27) in the area where the bevel side gears (5) and pinion gear shafts (6) mesh. Replace case if machined areas are scored or if the pinion shaft (25) fits loosely in its bore (Fig. 28).

IMPORTANT: The ring gear (32) and pinion gear (8) must be replaced as a matched set.

4. Inspect bevel side gears (5), pinion gear shafts (6), pinion gear (8), and ring gear (32) for abnormal wear or damage. Replace any gear that is worn or damaged. Cracked, broken, missing, or chipped gear teeth are not acceptable (Fig. 29).

IMPORTANT: If any part of a bearing needs replacement, both bearing cone and cup must be replaced.

5. Replace bearing cones (9, 22, or 29) and corresponding bearing cups (10, 23, or 30) if any of the following conditions occur (Fig. 30 and 31):

- A. Spalling or pitting on roller or cone contact surfaces. Corrosion that can not be cleaned up with light polishing.
- B. The rib face on the cone is worn back, or rollers are worn or scored. The roller cage is cracked or broken.
- C. Peeling, gouges, or nicks inside the cup or on rollers. Scalloping, high spots, brinelling, or burrs in the cups.



Figure 28



Figure 29



Figure 30

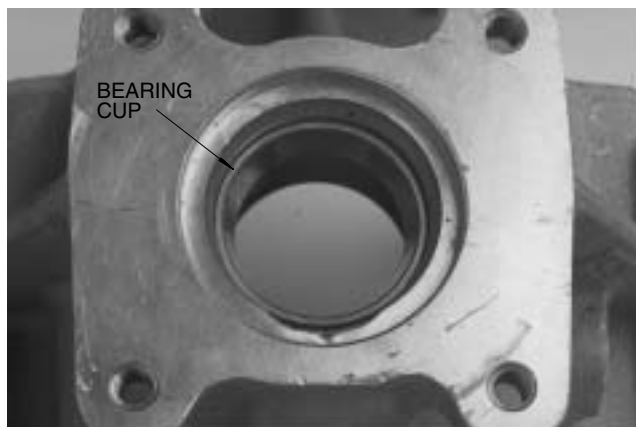


Figure 31

Diagram illustrating the exploded view of a differential assembly, showing the following components and their assembly sequence:

- RING GEAR (32)
- CAP SCREW (26)
- DIFFERENTIAL CASE (27)
- SHIM (31)
- BEARING CONE (29)
- BEARING CUP (30)
- BEARING CONE (9)
- BEARING SPACER (24)
- BEARING CONE (22)
- COUPLER FLANGE (19)
- WASHER (17)
- LOCK NUT (18)
- PINION SHAFT (25)
- PINION GEAR (6)
- THRUST WASHER (7)
- THRUST WASHER (4)
- SIDE BEVEL GEAR (5)
- CAP SCREW (11)
- BEARING CAP
- BEARING CRADLE
- 3.750 INCH
- ROLL PIN (28)
- CARRIER ASSEMBLY (15)
- BEARING CUP (10)
- SHIMS (14)
- SHIMS (21)
- BEARING CUP (23)
- OIL SEAL (20)
- PERMATEX

NOTE: In Figure 32, numbers in parentheses () correspond to the reference numbers in Figure 11.

The ring gear (32) and pinion gear (8) are supplied as a matched set. Both gears are etched for verification with matching numbers. If a new gear set is being used, verify that the matching numbers are the same on both the ring and pinion gear before assembling the front differential (Fig. 33).

The distance from the center line of the ring gear to the bottom of the pinion gear teeth is 3.750 inches (5.525 cm). This distance represents the best running position for the gear set (Fig. 32).

On the end of each pinion gear, there is an etched number indicated by plus (+), minus (–), or zero (0). This number indicates a shimming dimension for the best running position of the gear set. This dimension is controlled by shimming between the bearing cup (10) and the carrier assembly (15) (Fig. 33).

For example: If a pinion gear shaft is etched +4, this pinion would require 0.004 inch less shims than a pinion etched "0". By removing shims, the running position is increased to 3.754 inches. The +4 represents a 0.004 inch increase in the running position. On the other hand: If a pinion gear shaft is etched –4, this pinion would require 0.004 inch more shims than a pinion etched "0". By adding shims, the running position is decreased to 3.746 inches. The –4 represents a 0.004 inch decrease in the running position.

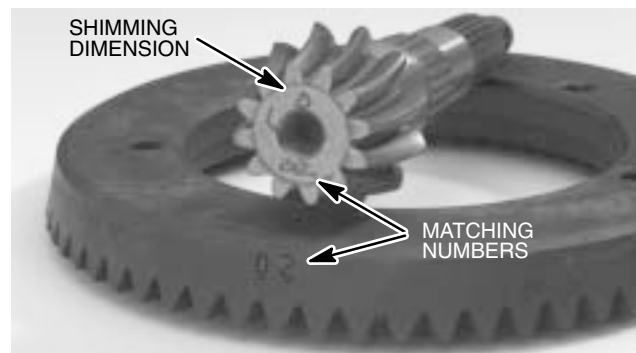


Figure 33

When reusing an old ring gear and pinion gear shaft set, measure the old shim pack thickness and build a new shim pack to the same thickness. Measure each shim separately with a micrometer. Add each shim thickness to get the total shim pack thickness.

If a new gear set is being used, note the (+) or (–) etching on both the old and new pinion gear shaft. Change the thickness of the new shim pack to compensate for the difference between these two dimensions.

For example: If the old pinion gear shaft reads + 2 and the new gear is –2, add 0.004 inch of shims to the old shim pack (see Table 1).

NOTE: All shims (14, 21, and 31) are available in thicknesses of 0.003, 0.005, 0.010, and 0.030 inch.

Old Pinion Marking	New Pinion Marking								
	–4	–3	–2	–1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	–0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	–0.001	–0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	–0.001	–0.002	–0.003
0	+0.004	+0.003	+0.002	+0.001	0	–0.001	–0.002	–0.003	–0.004
–1	+0.003	+0.002	+0.001	0	–0.001	–0.002	–0.003	–0.004	–0.005
–2	+0.002	+0.001	0	–0.001	–0.002	–0.003	–0.004	–0.005	–0.006
–3	+0.001	0	–0.001	–0.002	–0.003	–0.004	–0.005	–0.006	–0.007
–4	0	–0.001	–0.002	–0.003	–0.004	–0.005	–0.006	–0.007	–0.008

Table 1

1. If the bearing cone (9) was removed, press new bearing cone onto the shaft of the pinion gear (8) (Fig. 34).



Figure 34

2. If the bearing cup (23) was removed, press new bearing cup into the carrier assembly (15) (Fig. 35).
3. If the bearing cup (10) was removed, place shims (14) into the carrier assembly (15). Press new bearing cup into the assembly (Fig. 36).
4. If a **new** carrier assembly (15) is being installed, proceed as follows:

A. Press bearing cup (10) into the assembly with out any shims (14).

B. Place pinion gear (8) with bearing cone (9) installed into the carrier assembly and bearing cup.

C. Measure and note distance from the centerline of the ring gear to the bottom of the pinion gear teeth using a depth micrometer (Fig. 32 and 37).

D. Note shimming dimension on the pinion gear (Fig. 33). If the dimension is (+) positive, add the dimension to 3.750 inch. If the dimension is (–) negative, subtract the dimension from 3.750 inch.

For Example: If the pinion gear shaft is etched +4. Add 0.004 to 3.750 to get 3.754 inch. If the pinion gear shaft is etched –4. Subtract 0.004 from 3.750 to get 3.746 inch.

E. Now determine the difference between the measurement taken in a step C and the value calculated in step D. This difference is the **new** shim thickness.

F. Remove bearing cup from the carrier assembly.

G. Install required shim thickness and bearing cup into the carrier assembly.

IMPORTANT: The pinion gear (8) and ring gear (32) are supplied only as a matched set. Matching numbers on both gears are etched for verification. When using a new gear set, make sure the matching numbers are verified before using (Fig. 33).

5. Install pinion gear (8) and bearing cone (9) into the carrier assembly (15). Place bearing spacer (24), shims (21), and bearing cone (22) on to the shaft of the pinion gear (Fig. 38).



Figure 35



Figure 36



Figure 37



Figure 38

6. Verify bearing preload and pinion gear shaft (8) rotation as follows:

A. Install coupler flange (19), washer (17), and lock nut (18) to the shaft of the pinion gear. Torque lock nut from 75 to 90 ft-lb (102 to 122 N-m).

B. The torque required to rotate the shaft of the pinion gear should be from 7 to 12 in-lb (8 to 14 kg-cm) (Fig. 39).

C. If the torque required to rotate the shaft of the pinion gear is more than specified in step B, remove lock nut, washer, coupler flange, bearing cone (22), and shim (21) from the shaft of the pinion gear. **Increase** shim thickness to **decrease** bearing preload.

D. If the torque required to rotate the pinion gear shaft is less than specified in step B, remove lock nut, washer, coupler flange, bearing cone (22), and shim (21) from the pinion gear shaft. **Decrease** shim thickness to **increase** bearing preload.

E. Install shim, bearing cone, coupler flange, washer, and lock nut to the pinion gear shaft. Torque lock nut from 75 to 90 ft-lb (102 to 122 N-m).

F. The torque required to rotate the pinion gear shaft should be from 7 to 12 in-lb (8 to 14 kg-cm). If the torque to rotate the pinion gear shaft does not meet specification, repeat steps C or D and E as necessary.

G. If the torque required to rotate the shaft of the pinion gear shaft is as specified in step B or F, remove lock nut, washer, coupler flange, bearing cone (22) from the shaft of the pinion gear. Press new oil seal (20) into the carrier assembly (15) (Fig. 40).

H. Apply No. 2 Permatex sealant or equivalent to the splines of the pinion gear. **Make sure not to get sealant on the oil seal (20)** (Fig. 41).

I. Install flange coupler, washer, and lock nut back onto the pinion gear. Torque lock nut from 75 to 90 ft-lb (102 to 122 N-m).

7. Install thrust washers (7) to pinion gear shafts (6), and thrust washers (4) to side bevel gears (5) (Fig. 42).

A. Place gears and washers into the differential case (27).

B. Rotate both sets of gears simultaneously until the pinion shaft (25) can be inserted through the differential case, thrust washers, and pinion gear shafts.

C. Install pinion shaft into the differential case and pinion gear shafts. Secure shaft with roll pin (28).



Figure 39



Figure 40

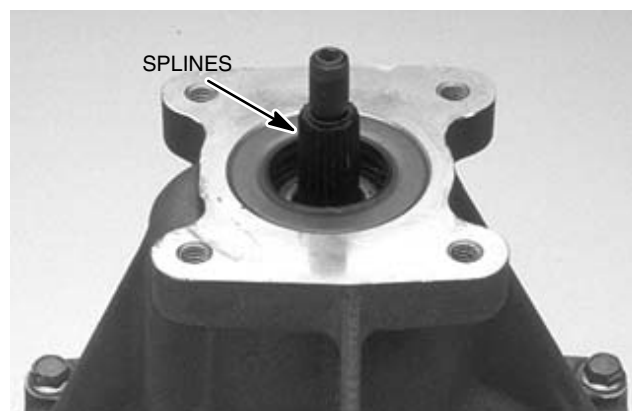


Figure 41



Figure 42

IMPORTANT: When bearing cones (29) are removed from the differential case (27) they should be replaced with new ones. When installing new bearing cones to the differential case, use original shims (31) or new shims of the same thickness.

8. Press bearing cone (29) onto the differential case (27) (Fig. 43).

9. Position ring gear (32) to the differential case (27). Secure ring gear to the case with five cap screws (26) in a criss-cross pattern so the gear is pulled evenly into place. Torque cap screws from 58 to 65 ft-lb (79 to 88 N-m) (Fig. 44).

NOTE: The bearing cradles are designed to apply a slight preload to the bearings. Therefore, it is important to push both bearing assemblies simultaneously into their cradles.

IMPORTANT: If new bearing cones (29) were installed onto the differential case (27), new bearing cups (30) must be installed to the bearing cradles.

10. Place bearing cups (30) onto bearing cones (29). Install bearing assemblies into the bearing cradles of the carrier assembly (15). Make sure bearing cups (30) are matched to the proper bearing cradle and bearing cone (29) (Fig. 45).

IMPORTANT: The bearing caps are marked for identification. Place caps back in the same position during reassembly (Fig. 46).

11. Secure bearing caps to their original positions on the bearing cradles with four cap screws (11). Torque cap screws from 30 to 45 ft-lb (41 to 61 N-m) (Fig. 46).



Figure 43

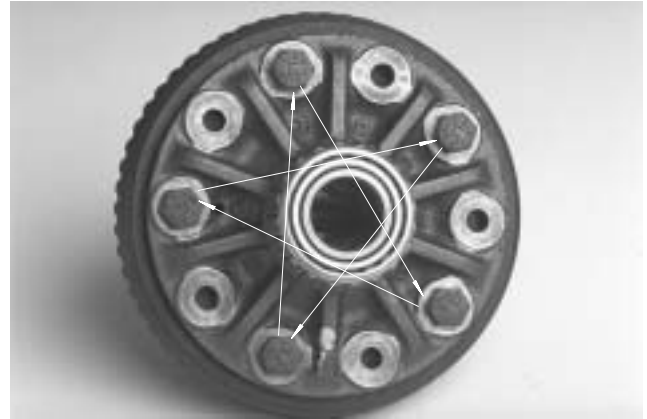


Figure 44



Figure 45

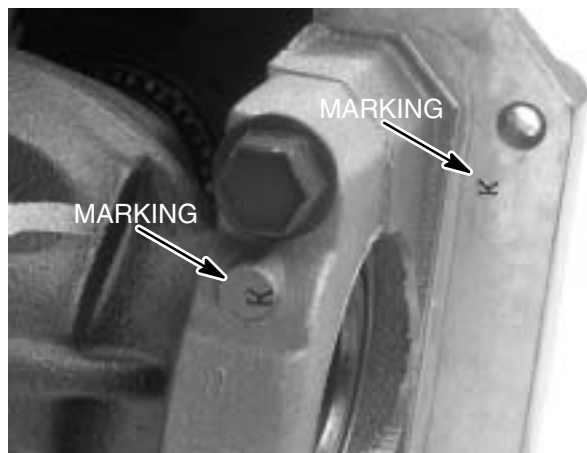


Figure 46

12. Check backlash of ring gear (32) with a dial indicator at three equally spaced positions (Fig. 47).

A. Backlash should be from 0.002 to 0.006 inch (0.051 to 0.152 mm) and should not vary more than 0.002 inch (0.051 mm).

B. If backlash does not meet specifications, move shims (31) from one side of the differential case (27) to the other until the correct backlash is attained.

13. Check ring to pinion gear engagement (see Ring and Pinion Gear Engagement in this chapter of the manual).

14. If the needle bearings (34) were removed, press two new bearings into the front housing (2). Press new oil seals into housing (Fig. 48).

15. Make sure flange surface of carrier assembly (15) is clean and free of any sealant, dirt, and oil. Apply thin bead of non-acidic silicon sealer along the entire flange surface of the carrier assembly (Fig. 49).

16. Make sure flange surface of front housing (2) is clean and free of any sealant, dirt, and oil. Attached front housing to the carrier assembly (15) using alignment pins (3) as guides. Secure housing to assembly with eight cap screws (16). Torque cap screws from 15 to 20 ft-lb (20 to 27 N-m) using a criss-cross pattern (Fig. 50).



Figure 47



Figure 48

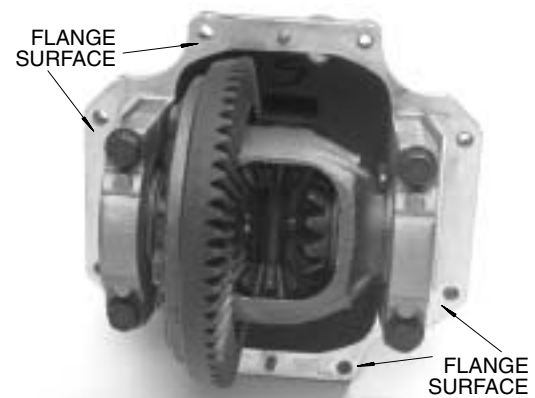


Figure 49



Figure 50

17. Make sure both plugs (12) and O-rings (13) are installed. Verify that plugs are torqued between 20 to 25 ft-lb (27 to 33 N-m).

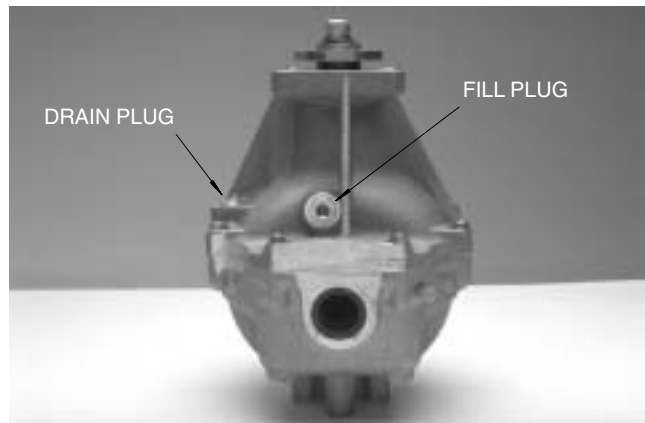


Figure 51

Ring to Pinion Gear Engagement

When replacing the ring and pinion gear set, final position of pinion is verified by using the gear contact pattern method as described in the following procedure. **NOTE:** engagement contact of original production ring and pinion gear may differ slightly from gear pattern shown.

GEAR TOOTH DEFINITIONS (Fig. 52):

Toe - the portion of the tooth surface at the end towards the center.

Heel - the portion of the gear tooth at the outer end.

Top Land - top surface of tooth.

1. Paint the teeth of the ring gear, both drive and coast side, with a gear marking compound, such as DyKem® Steel Blue.

2. While applying a light load to the ring gear, rotate the pinion gear until the ring gear has made one complete revolution. Both the drive side pattern and the coast side pattern on the ring gear should be at the toe portion of the tooth (Fig. 53).

Study the patterns in the following illustrations and correct engagement as necessary.

NOTE: When making changes, note that two variables are involved. Example: If you have the backlash set correctly to specifications and you change the pinion position shim, you may have to readjust backlash to the correct specification before re-checking the pattern.

Every gear has a characteristic pattern. The illustrations show typical patterns only and explain how patterns shift as gear location is changed. When making pinion position changes, shims should be changed in the range of .002" to .004" until a correct pattern has been obtained.

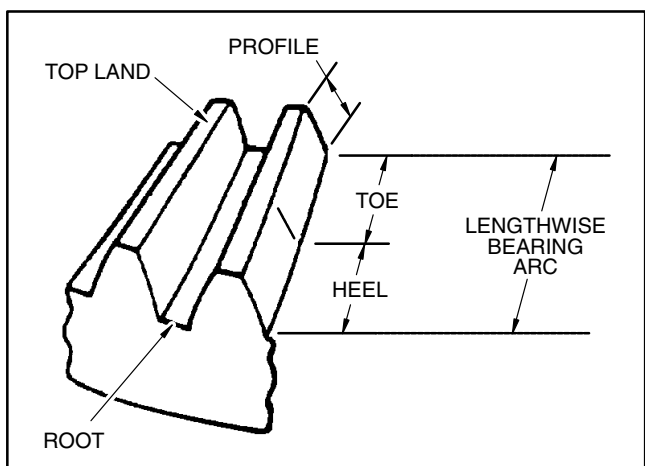


Figure 52

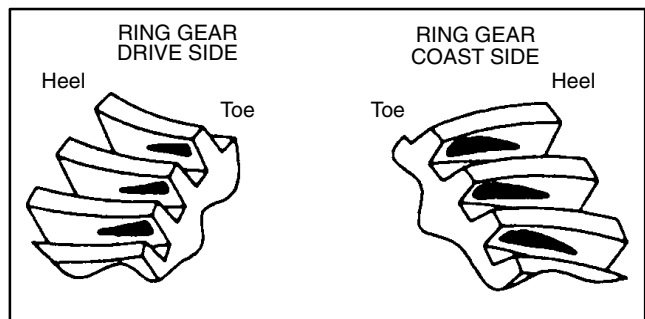


Figure 53

When a change in backlash is required, backlash shims should be changed in the range of 1-1/2 times the amount of backlash required to bring the gears into specification. For example, if the backlash needed to be changed by .004", the shim pack should be changed by .006" as a starting point.

High backlash is corrected by moving the ring gear closer to the pinion. Low backlash is corrected by moving the ring gear away from the pinion. These corrections are made by switching shims from one side of the differential case to the other.

Example 1: Backlash correct. Thicker pinion position shims required (Fig. 54).

Example 2: Backlash correct. Thinner pinion position shims required (Fig. 55).

Example 3: Backlash incorrect. Thinner pinion position shim required. Adjust backlash to match (Fig. 56).

GEAR PATTERN MOVEMENT SUMMARY:

1. Decreasing backlash moves the ring gear closer to the pinion.

A. Drive pattern (convex side of gear) moves lower and toward the toe.

B. Coast pattern (concave side of gear) moves slightly higher and toward the heel.

2. Increasing backlash moves the ring gear away from the pinion.

A. Drive pattern (convex side of gear) moves higher and toward the heel.

B. Coast pattern (concave side of gear) moves slightly lower and toward the toe.

3. Thicker pinion position shim with the backlash constant moves the pinion closer to the ring gear.

A. Drive pattern (convex side of gear) moves deeper on the tooth (flank contact) and slightly toward the toe.

B. Coast pattern (concave side of gear) moves deeper on the tooth and toward the heel.

4. Thinner pinion position shim with backlash constant moves the pinion further from the ring gear.

A. Drive pattern (convex side of gear) moves toward the top of the tooth (face contact) and toward the heel.

B. Coast pattern (concave side of gear) moves toward the top of the tooth (face contact) and toward the heel.

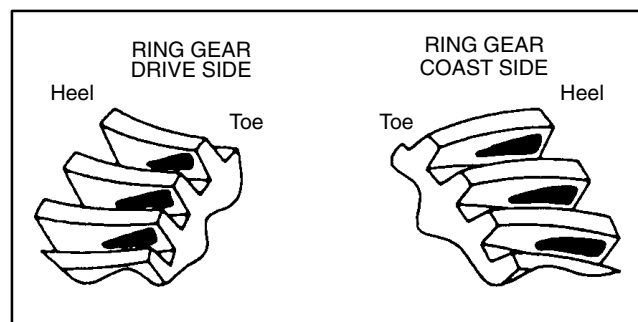


Figure 54

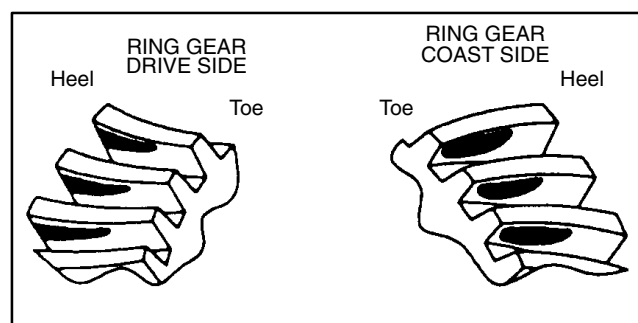


Figure 55

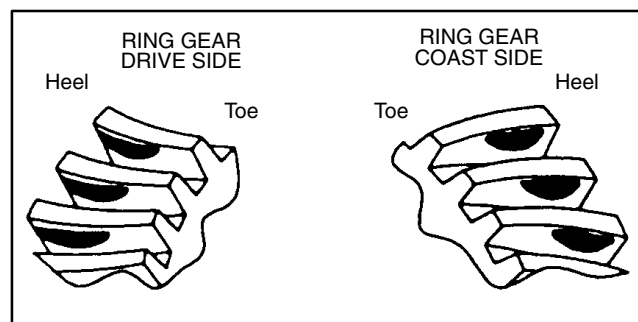


Figure 56

Differential Drive Shaft

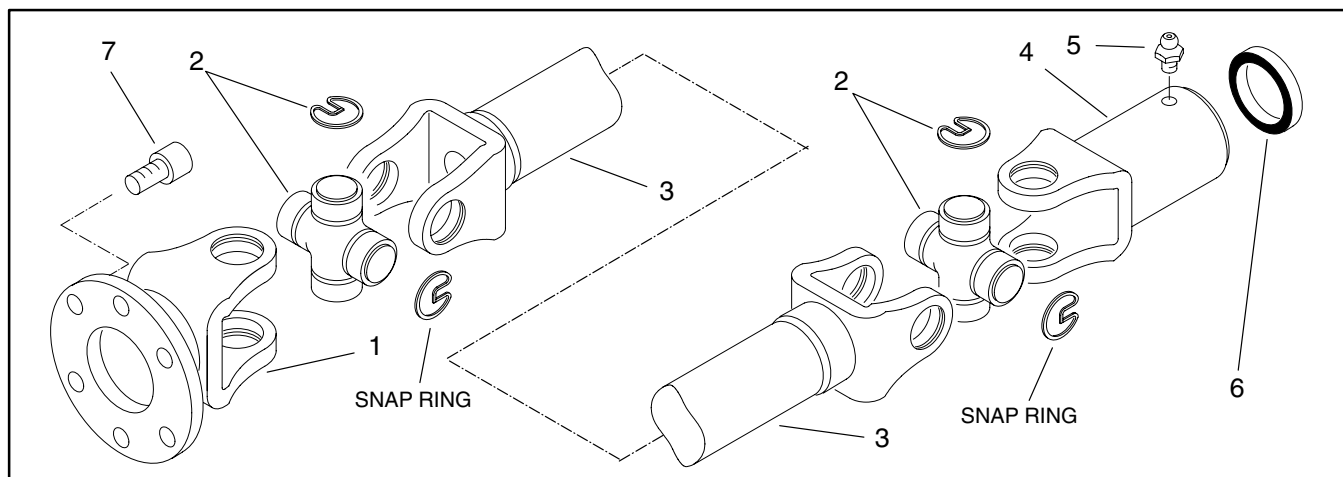


Figure 57

- 1. Flange yoke
- 2. Cross and bearing kit
- 3. Tube yoke

- 4. Slip yoke
- 5. Grease fitting

- 6. Seal
- 7. Socket head screw (6 used)

Removal

1. Park vehicle on a level surface. Make sure engine is off. Engage parking brake and block rear wheels.
2. Jack up and secure front wheels off the ground (see Jacking Instructions in Operator's Manual).



WARNING

Prevent flange yoke from dropping and causing personal injury when removing.

3. Remove six socket head screws securing the differential drive shaft flange yoke to the coupler flange on the front differential (Fig. 58).

4. Slide slip yoke towards the bidirectional clutch. Pull slip yoke off the clutch shaft (Fig. 59).

Installation

1. Slide slip yoke onto clutch shaft (Fig. 59).
2. Position flange yoke to the coupler flange on the front differential. Secure yoke to the flange with six socket head screws (Fig. 58).
3. Grease differential drive shaft assembly (see Operators Manual).

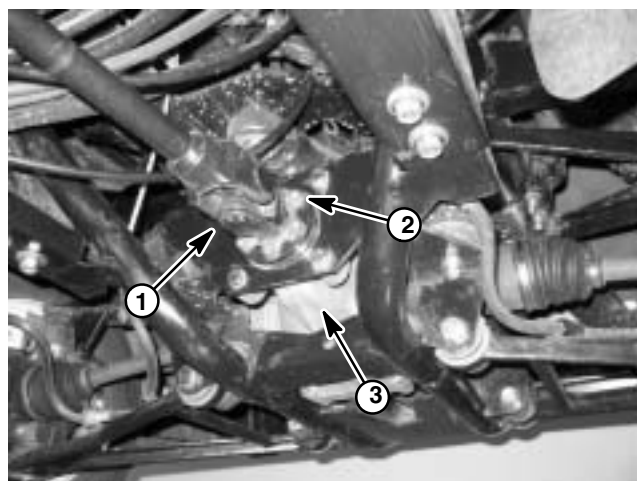


Figure 58

- 1. Flange yoke
- 2. Socket head screw
- 3. Front differential

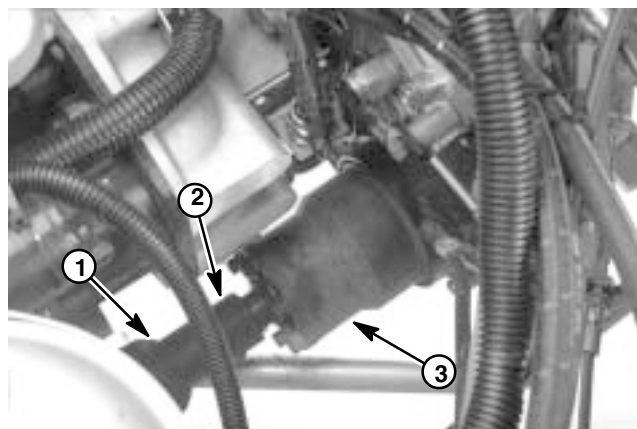


Figure 59

- 1. Slip yoke
- 2. Clutch shaft
- 3. Bidirectional clutch

Drive Shaft Cross and Bearing Service

1. Remove drive shaft from vehicle (see Differential Drive Shaft Removal).

2. Remove snap rings that secure bearings.

IMPORTANT: Yokes must be supported when removing and installing bearings to prevent damage.

3. Use a press to remove cross and bearings from yokes. Thoroughly clean drive shaft yokes.

4. To install new cross and bearings:

A. Apply a coating of grease to all bearing bores.

B. Press one bearing partially into yoke.

C. Insert cross into yoke and bearing.

D. Hold cross in alignment and press bearing in until it hits the yoke.

E. Install snap ring into yoke groove to secure installed bearing.

F. Place second bearing into yoke bore and onto cross shaft. Press bearing into yoke and secure with snap ring.

G. Repeat procedure for other yoke.

H. Grease cross until grease comes out of all four (4) cups.

5. Reinstall drive shaft to vehicle (see Differential Drive Shaft Installation).

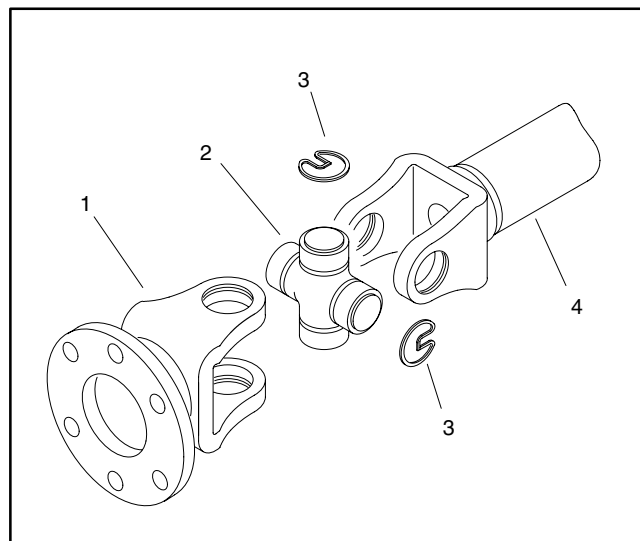


Figure 60

- | | |
|--------------------------|-----------------------|
| 1. Flange yoke | 3. Snap ring (4 used) |
| 2. Cross and bearing kit | 4. Tube yoke |

Bidirectional Clutch

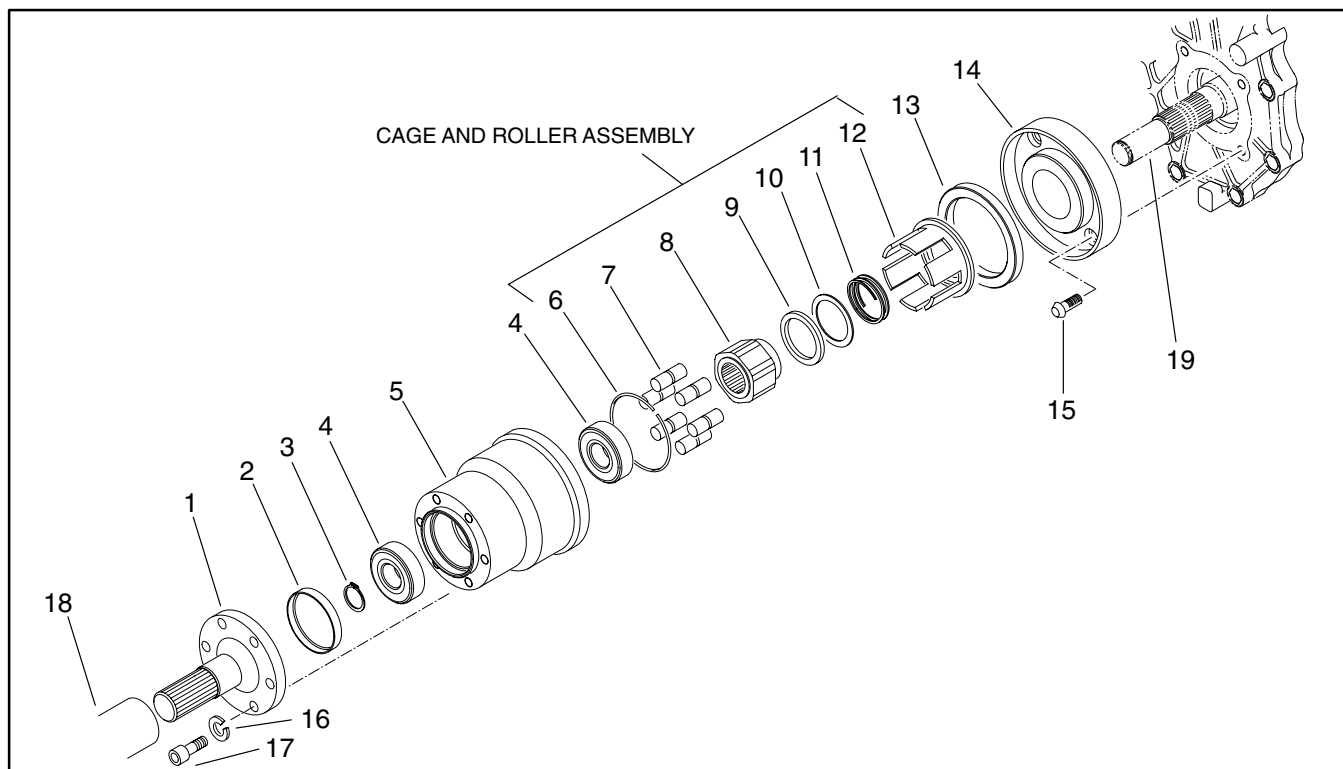


Figure 61

- | | | |
|---------------------|-------------------|------------------------------------|
| 1. Clutch shaft | 8. Cam | 14. Adapter plate |
| 2. Seal plug | 9. Thrust bearing | 15. Screw (4 used) |
| 3. Retaining ring | 10. Thrust washer | 16. Lock washer (6 used) |
| 4. Ball bearing | 11. Spring | 17. Hex socket head screw (6 used) |
| 5. Housing and race | 12. Cage | 18. Differential drive shaft |
| 6. Garter gear | 13. Oil seal | 19. Front drive shaft (transaxle) |
| 7. Roller (6 used) | | |

Removal (Fig. 61)

1. Park vehicle on a level surface. Make sure engine is off. Engage parking brake and block rear wheels.
2. Remove drain plug from the transaxle. Drain all transaxle oil into a suitable container. Install drain plug.
3. Jack up and secure front wheels off the ground (see Jacking Instructions in Operator's Manual).
4. Remove differential drive shaft (18) from clutch shaft (1) and the front differential (see Differential Drive Shaft Removal).
5. Remove six hex socket head screws (17) and lock washers (16) securing the clutch shaft (1) to the housing and race (5).
6. Remove seal plug (2) from the housing and race (5). Discard seal plug.
7. Remove retaining ring (3) from the transaxle front drive shaft (19) using a snap ring pliers. Discard snap ring if it is cracked, distorted, or bent.

IMPORTANT: When removing the bidirectional clutch from the front drive shaft (19), hold the bearing end of the housing and race (5) down as it is removed to prevent dropping of parts. Be careful not to damage oil seal (13) on drive shaft splines.

8. Pull bidirectional clutch (5 through 12) from the transaxle front drive shaft (19) and adaptor plate (14).

Disassembly (Fig. 61)

NOTE: The cage and roller assembly consists of the garter spring (6), rollers (7), cam (8), thrust bearing (9), thrust washer (10), spring (11), and cage (12).

1. Tilt bearing end of the clutch up and slowly pull cage and roller assembly out of the housing and race (5) as a complete assembly (see Fig. 62 and 63). **Be careful not to drop parts or damage oil seal.**
2. Pull ball bearings (4) and/or oil seal (13) if they require replacement (see Inspection).

Inspection (Fig. 61)

1. Replace cage (12) if it is bent, cracked, or broken. Corrosion that can not be cleaned up with light polishing is not acceptable.
2. Replace spring (11) if flattened or distorted.
3. Replace thrust washer (10) if flat surfaces are pitted, gouged, or distorted.
4. Replace thrust bearing (9) if bent, distorted, or the needles do not spin freely.
5. Replace rollers (7) or cam (8) if any of the following conditions occur:
 - A. Contact surfaces have excessive spalling or pitting. Peeling, gouges, or nicks are present.
 - B. Corrosion that can not be cleaned up with light polishing is present.
 - C. Roller ends are worn or scored. The rolling surface of the roller has any flat spots.
6. Replace garter spring (6) if it is distorted in any way that the rollers (7) are not held snugly by the cam (8) and cage (12) when assembled (Fig. 62).
7. Replace ball bearings (4) if any of the following conditions occur:
 - A. Play between bearing races and balls is excessive. The bearing cage is cracked or distorted.
 - B. The inner or outer bearing races are cracked, distorted, discolored from over heating, or corroded.
 - C. The balls are nicked, distorted, discolored from over heating, or corroded.
8. Replace oil seal (13) if its metal ring is distorted or bent. Distortion, cracks, or tears of the rubber seal is not acceptable.
9. Replace adapter plate (14) if the contact surface with the oil seal is nicked, cracked, or distorted (Fig. 65).



Figure 62



Figure 63

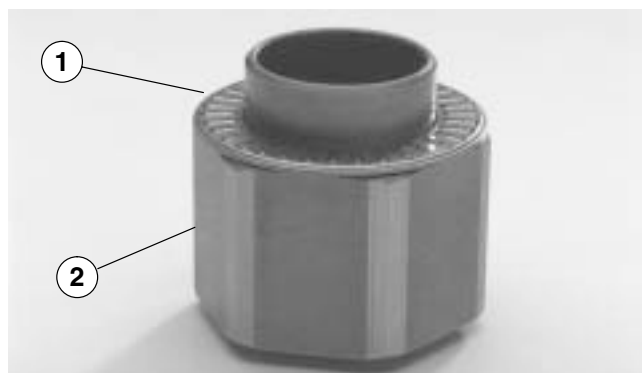


Figure 64

1. Thrust bearing

2. Cam



Figure 65

Assembly (Fig. 61)

1. Clean all parts thoroughly of all dirt and debris to prevent damage to the bidirectional clutch and transaxle.
2. Place garter spring around the cage and into the groove (Fig. 66).
3. Place thrust bearing, thrust washer, and spring onto the cam (Fig. 67).
4. Insert cam with thrust bearing, thrust washer, and spring into the cage (Fig. 68).

NOTE: Rollers must be replaced as a complete set.

5. Insert rollers into the slots of the cage. Make sure garter spring fits snugly into the groove of all rollers (Fig. 68).

NOTE: Both bearings must be replaced as a set.

6. If the ball bearings (4) were removed, press **new** bearings into the housing and race (5).
7. If the oil seal (13) was removed, press **new** seal into the housing and race (5). Make sure the metal side of the seal faces out from the housing.

Installation (Fig. 61)

1. Clean adapter plate (14) thoroughly of all dirt and debris to prevent damage to the bidirectional clutch and transaxle.
2. If the adapter plate (14) was removed from the transaxle, install as follows:
 - A. Make sure contact surfaces between the adapter plate and transaxle are free of dirt, debris, and oil.
 - B. Apply Loctite #59375 black silicone sealant or equivalent to the back side of the adapter plate.
 - C. Secure adapter plate to the transaxle with four screws (15). Make sure not to get sealant into the threaded holes of the transaxle.
3. Coat front drive shaft (19) and adapter plate (14) lightly with Dexron III ATF. Slide cage and roller assembly as a complete assembly (see Fig. 62) slowly onto the front drive shaft. Make sure large base end of the cage is installed first.
4. Position housing and race (5) over the cage and roller assembly. Make sure assembly parts are positioned properly by pushing the clutch towards the transaxle and feeling for spring (11) compression.

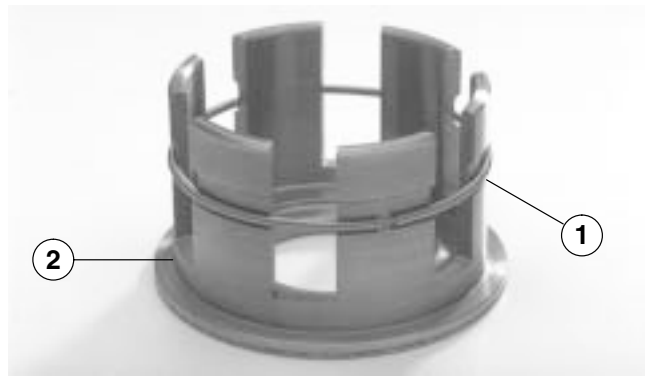


Figure 66

1. Garter spring
2. Cage



Figure 67

1. Thrust bearing
2. Thrust washer
3. Spring
4. Cam



Figure 68

1. Cam
2. Cage
3. Roller
4. Garter spring

IMPORTANT: Make sure retaining ring (3) is properly seated in the drive shaft (19) groove. Pull clutch out from the transaxle to make sure that it holds in place. Replace ring if bent or damaged.

5. Secure clutch to front drive shaft (19) with retaining ring (3).

IMPORTANT: Make sure rubber side of the seal plug (2) faces towards the clutch when installing.

6. Insert seal plug (2) into the housing and race (5) using a driver.

7. Secure clutch shaft to housing and race (5) with lock washers (16) and hex socket head screws (17).

8. Lower front wheels to ground.

9. Make sure drain plug is installed properly to the transaxle. Fill transaxle with Dexron III ATF (see Operators Manual).

10. Install differential drive shaft (18) to clutch shaft (1) and the front differential (see Differential Drive Shaft Installation).

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Electrical Schematics

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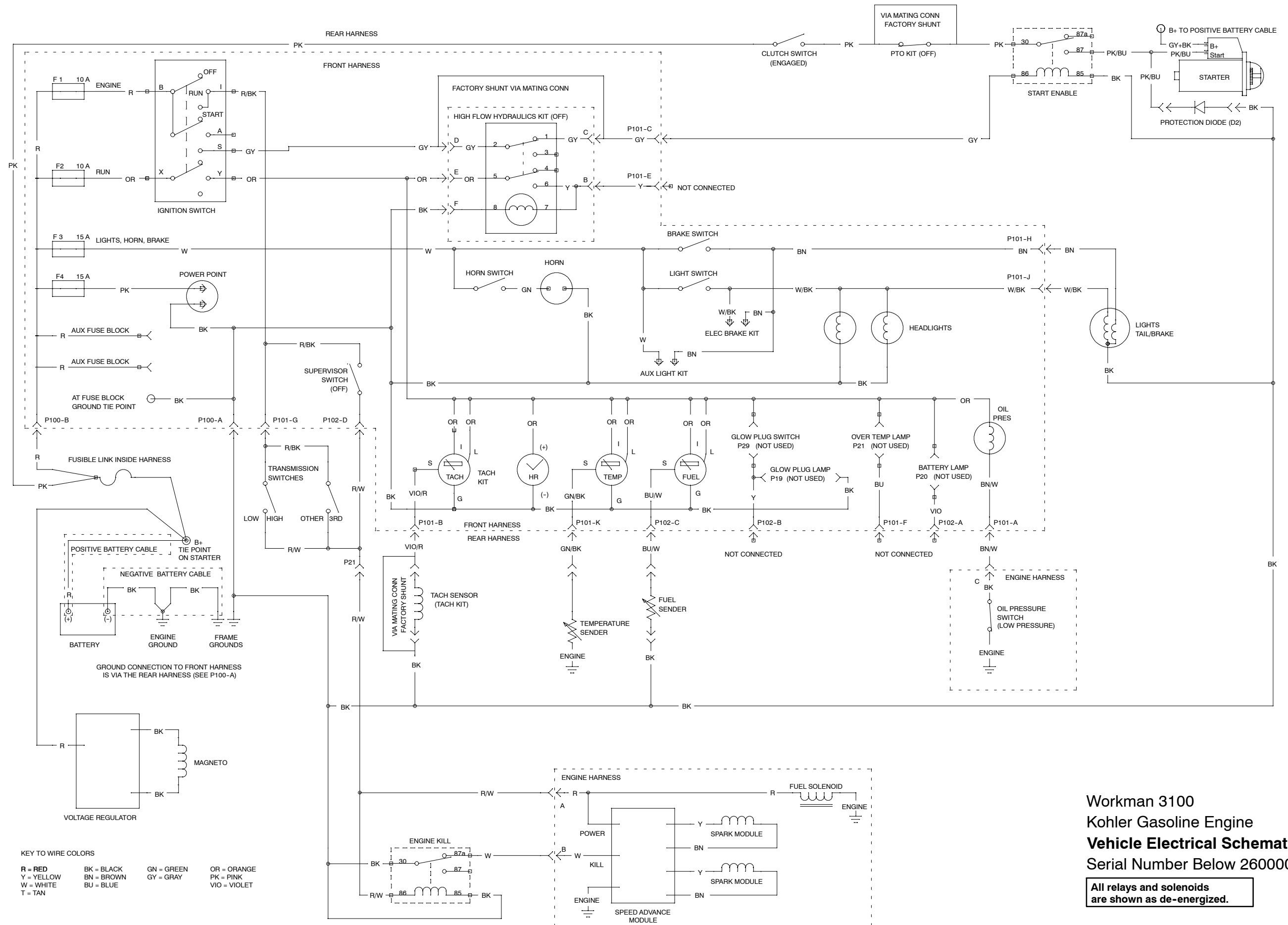
Rear Wire Harness Drawing: Workman 3200/4200

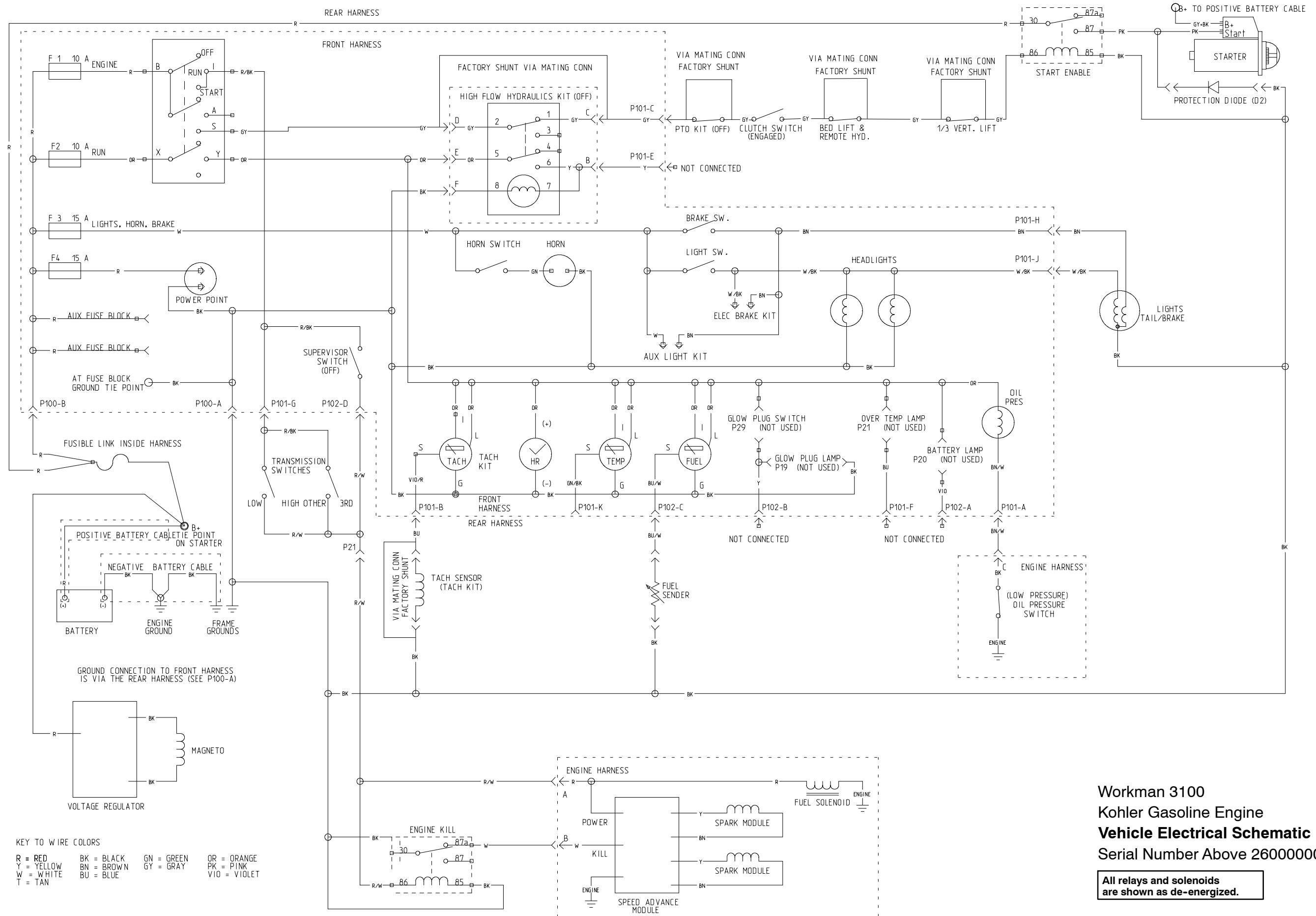
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Rear Wire Harness Diagram: Workman 3300/4300

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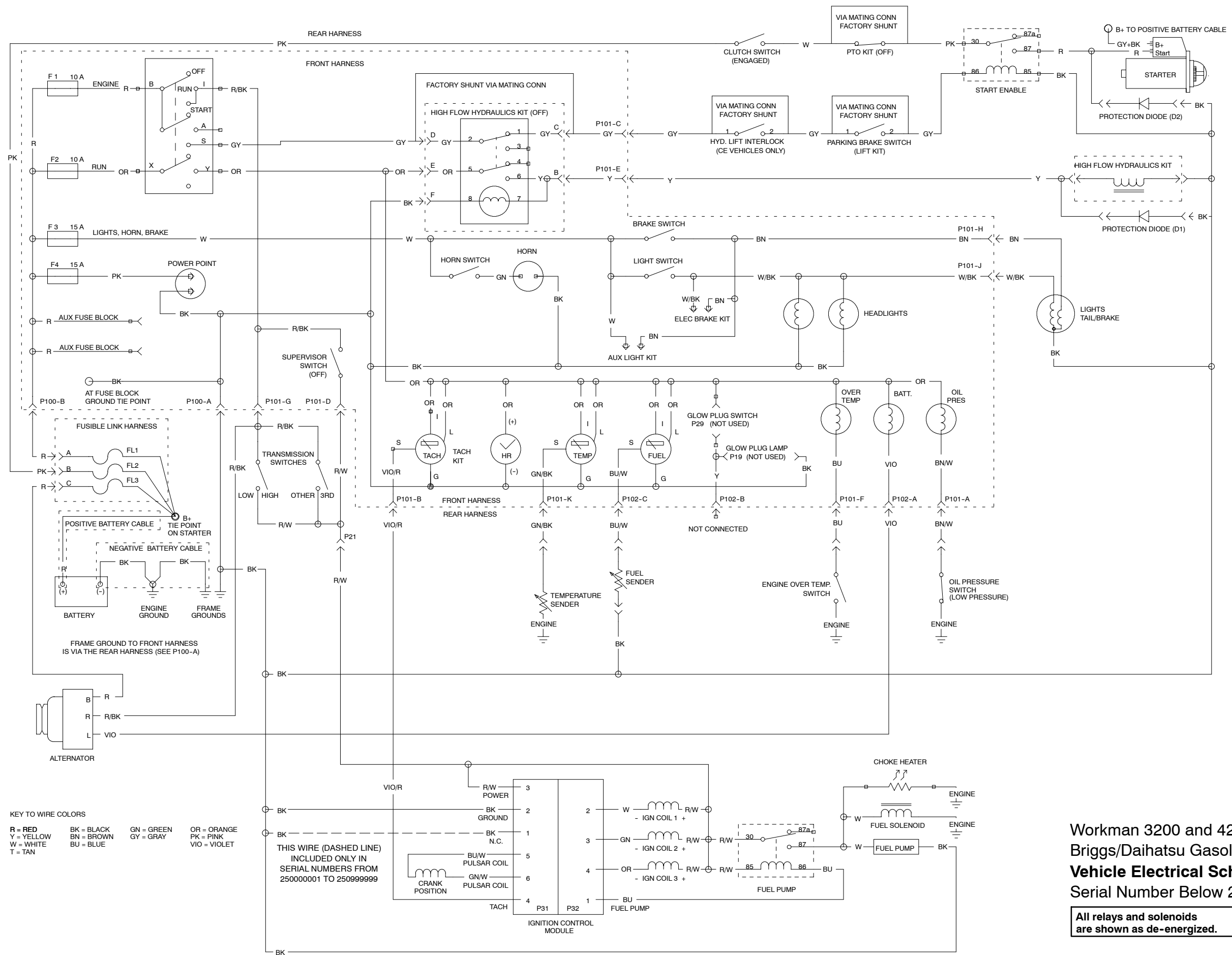
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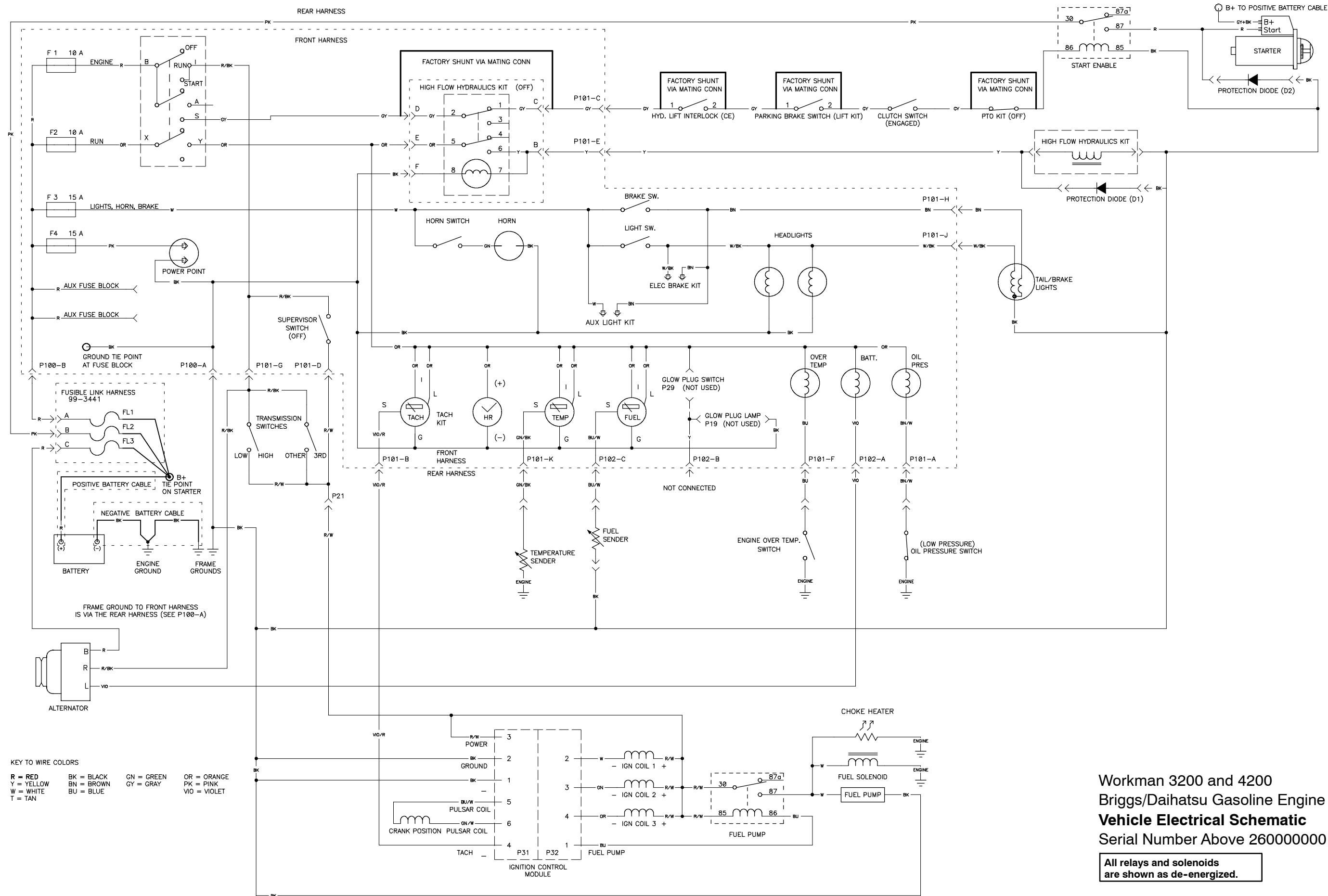


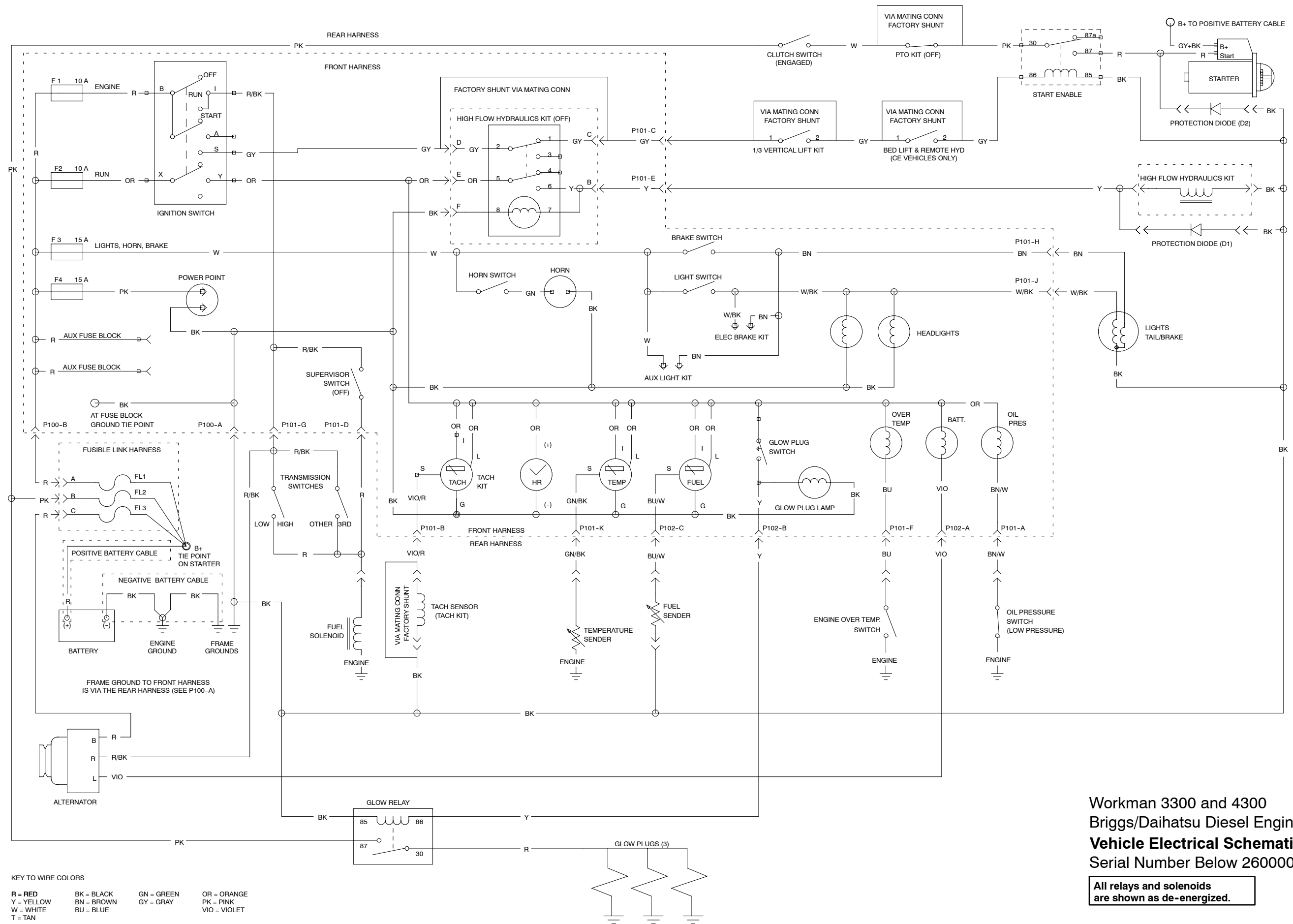
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Kohler Gasoline Engine
Vehicle Electrical Schematic
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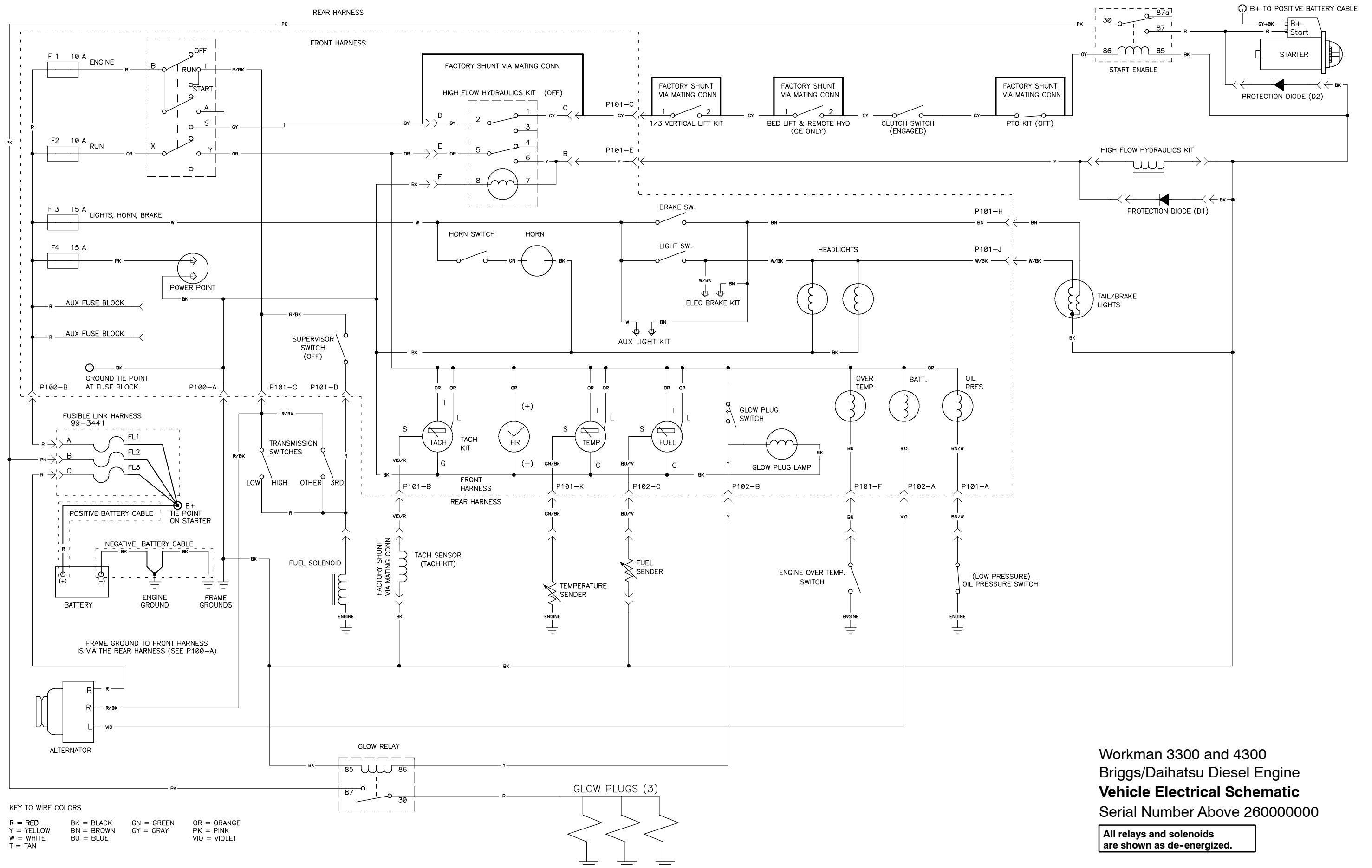
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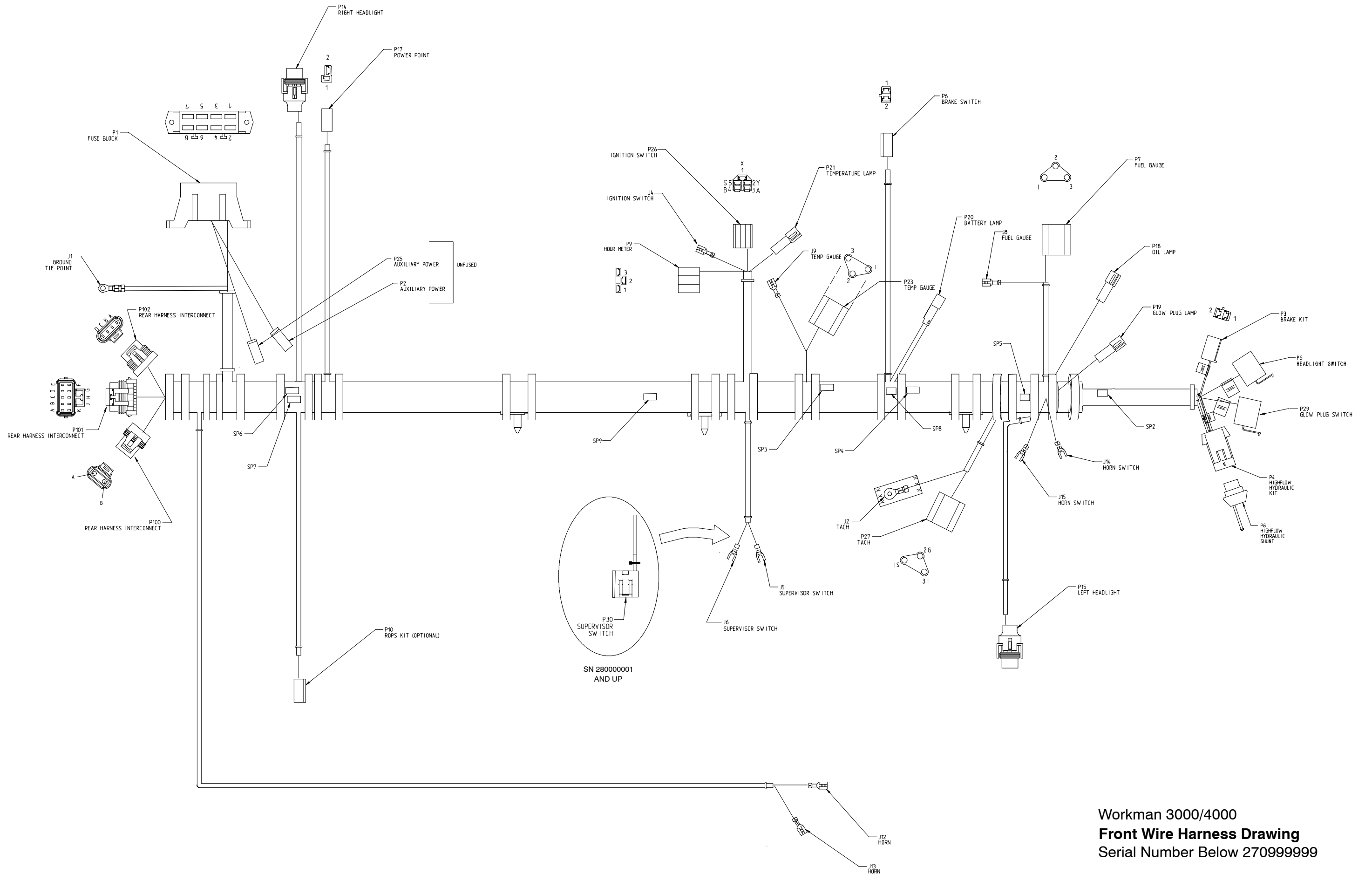
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Vehicle Electrical Schematic
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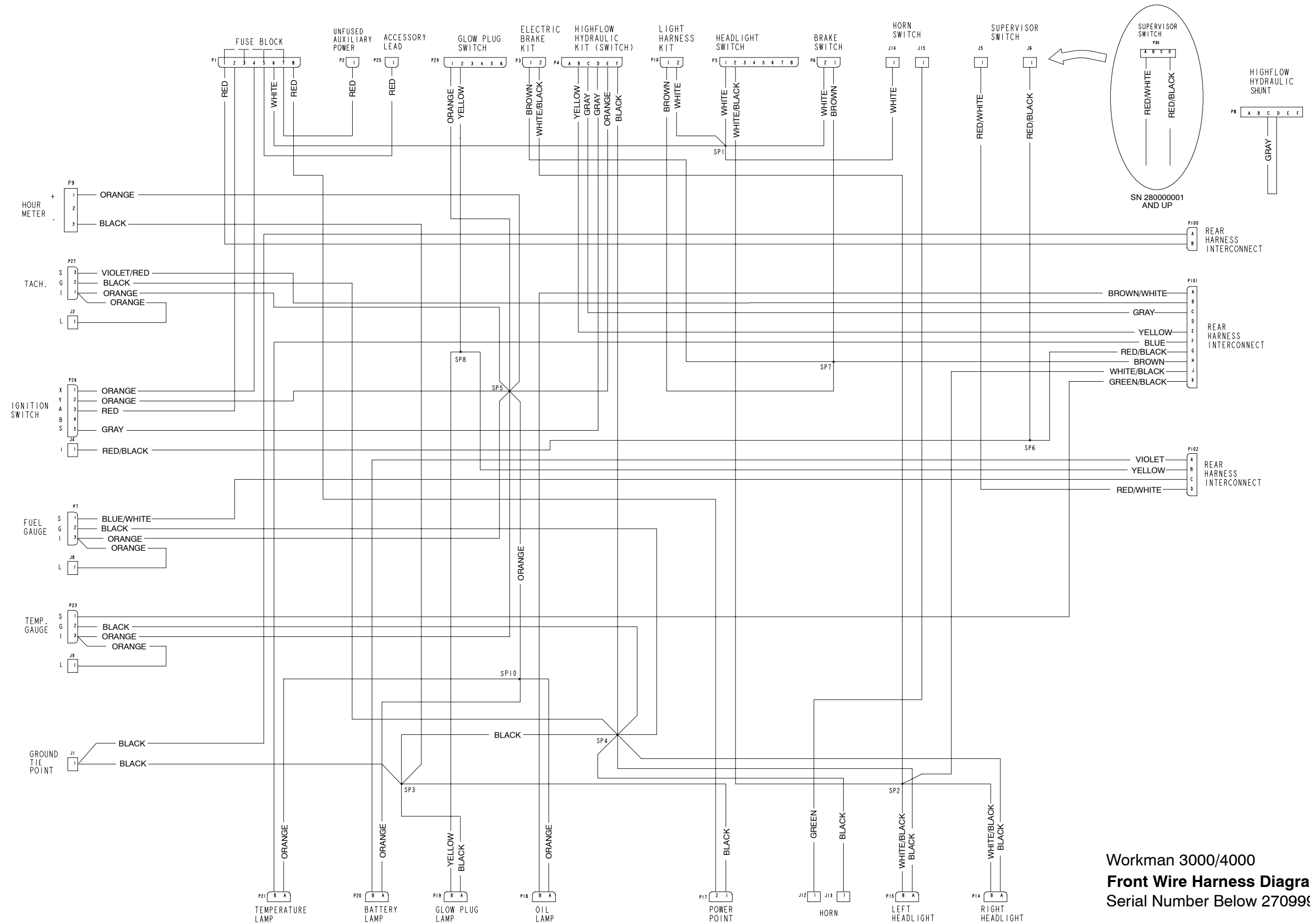




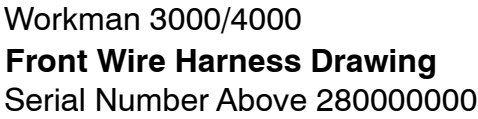


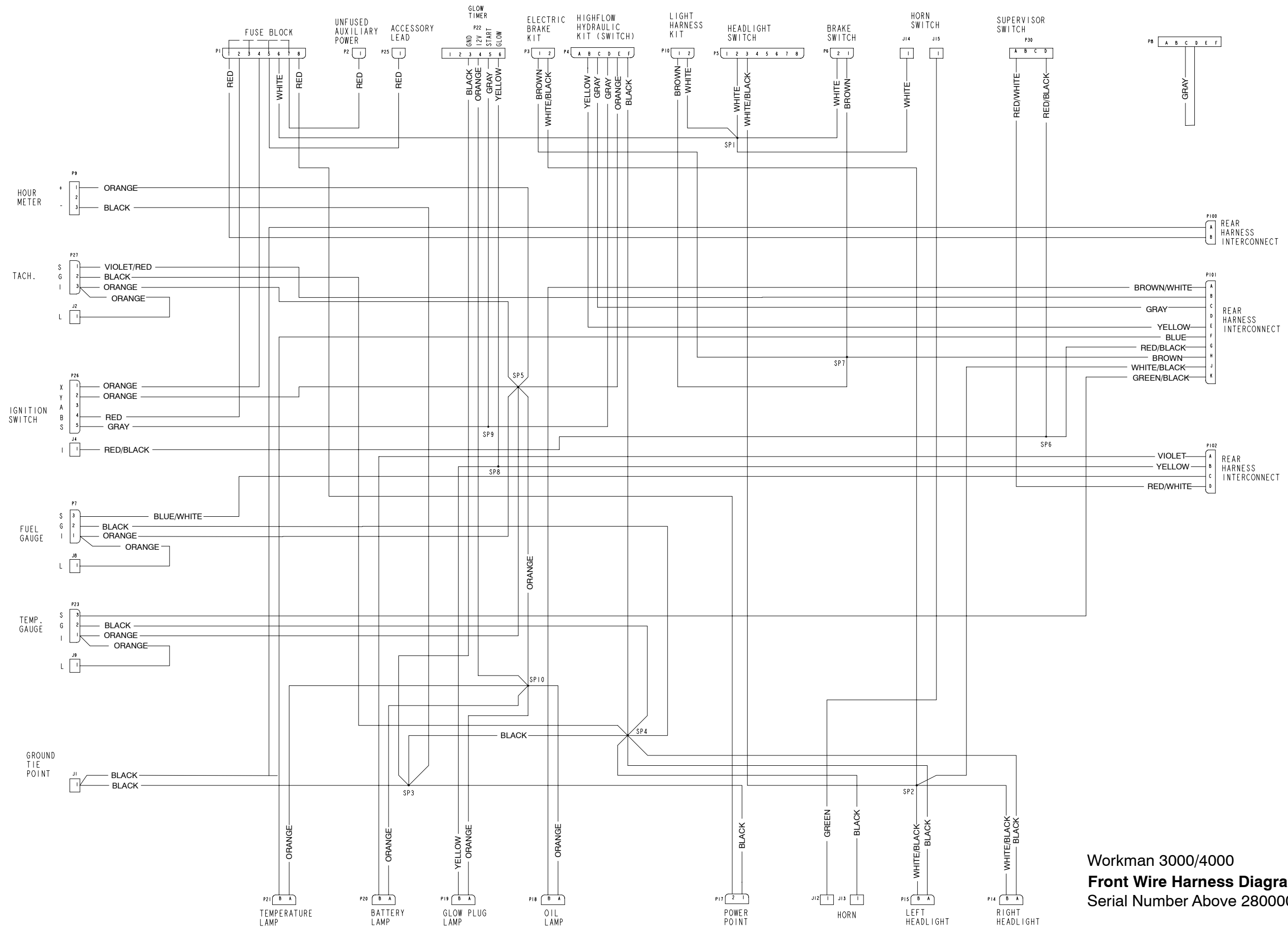
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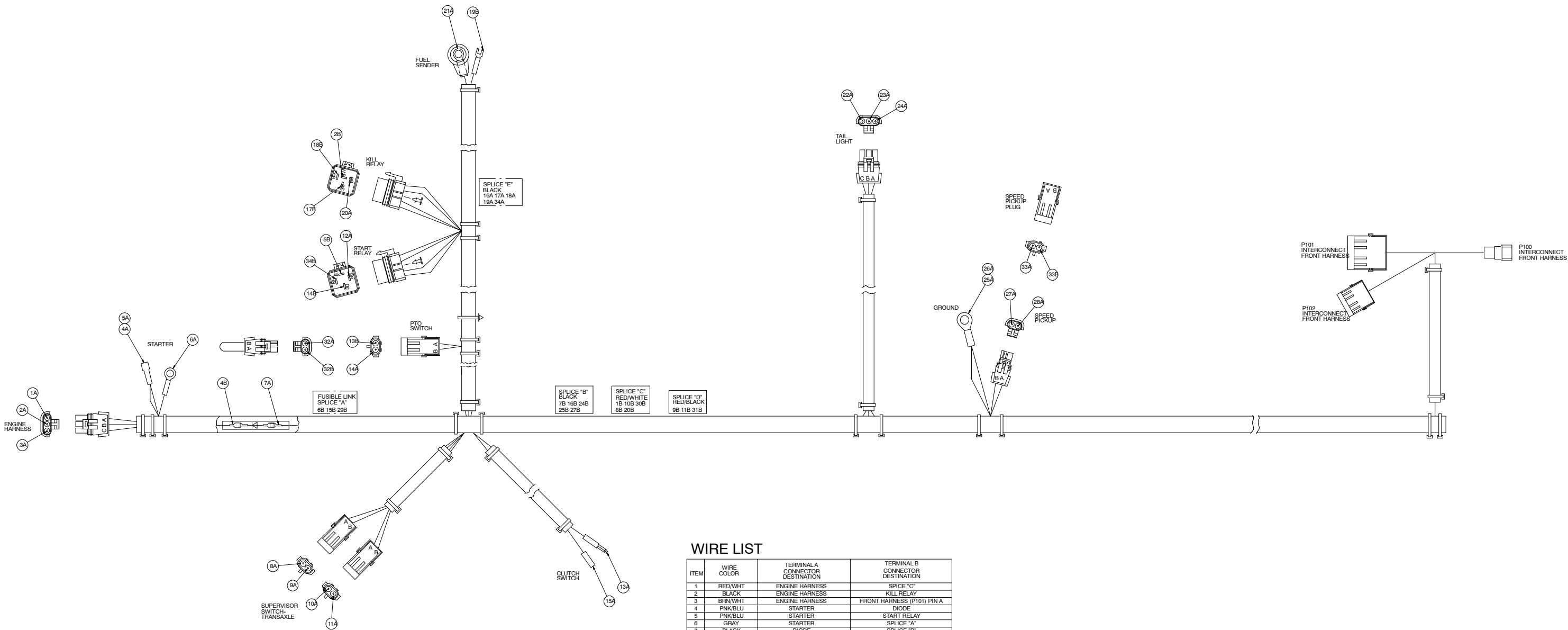


Workman 3000/4000
Front Wire Harness Diagram
 Serial Number Below 270999999





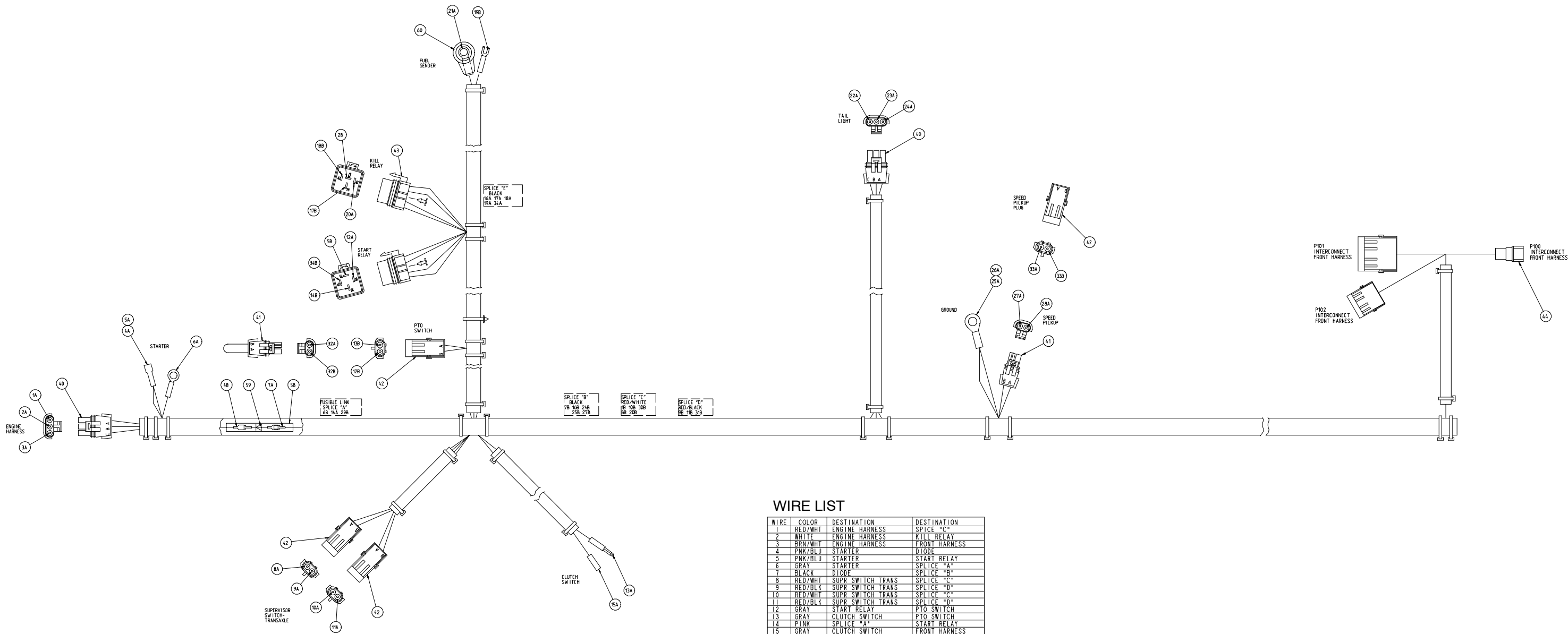
Workman 3000/4000
Front Wire Harness Diagram
Serial Number Above 280000000



WIRE LIST

ITEM	WIRE COLOR	TERMINAL A CONNECTOR DESTINATION	TERMINAL B CONNECTOR DESTINATION
1	RED/WHY	ENGINE HARNESS	SPICE "C"
2	BLACK	ENGINE HARNESS	KILL RELAY
3	BRN/WHY	ENGINE HARNESS	FRONT HARNESS (P101) PIN A
4	PNK/BLU	STARTER	DIODE
5	PNK/BLU	STARTER	START RELAY
6	GRAY	STARTER	SPICE "A"
7	BLACK	DIODE	SPICE "B"
8	RED/WHY	SUPR SWITCH TRANS	SPICE "C"
9	RED/BLK	SUPR SWITCH TRANS	SPICE "D"
10	RED/WHY	SUPR SWITCH TRANS	SPICE "C"
11	RED/BLK	SUPR SWITCH TRANS	SPICE "D"
12	GRAY	START RELAY	FRONT HARNESS (P101) PIN C
13	PINK	CLUTCH SWITCH	PTO SWITCH
14	PINK	PTO SWITCH	START RELAY
15	PINK	CLUTCH SWITCH	SPICE "A"
16	BLACK	SPICE "E"	SPICE "B"
17	BLACK	SPICE "E"	START RELAY
18	BLACK	SPICE "E"	START RELAY
19	BLACK	SPICE "E"	FUEL SENDER
20	RED/WHY	KILL RELAY	SPICE "C"
21	BLU/WHY	FUEL SENDER	FRONT HARNESS (P102) PIN C
22	BROWN	TAIL LIGHT	FRONT HARNESS (P101) PIN H
23	WHY/BLK	TAIL LIGHT	FRONT HARNESS (P101) PIN J
24	BLACK	TAIL LIGHT	SPICE "B"
25	BLACK	GROUND	SPICE "B"
26	BLACK	GROUND	FRONT HARNESS (P100) PIN A
27	BLACK	SPEED PICKUP	SPICE "B"
28	BLUE	SPEED PICKUP	FRONT HARNESS (P101) PIN B
29	RED	FRONT HARNESS (P100) PIN B	SPICE "A"
30	RED/WHY	FRONT HARNESS (P102) PIN D	SPICE "C"
31	RED/BLK	FRONT HARNESS (P101) PIN G	SPICE "D"
32	PINK	PTO SWITCH PLUG	PTO SWITCH PLUG
33	BLACK	SPEED PICKUP PLUG	SPEED PICKUP PLUG
34	BLACK	SPICE "E"	START RELAY

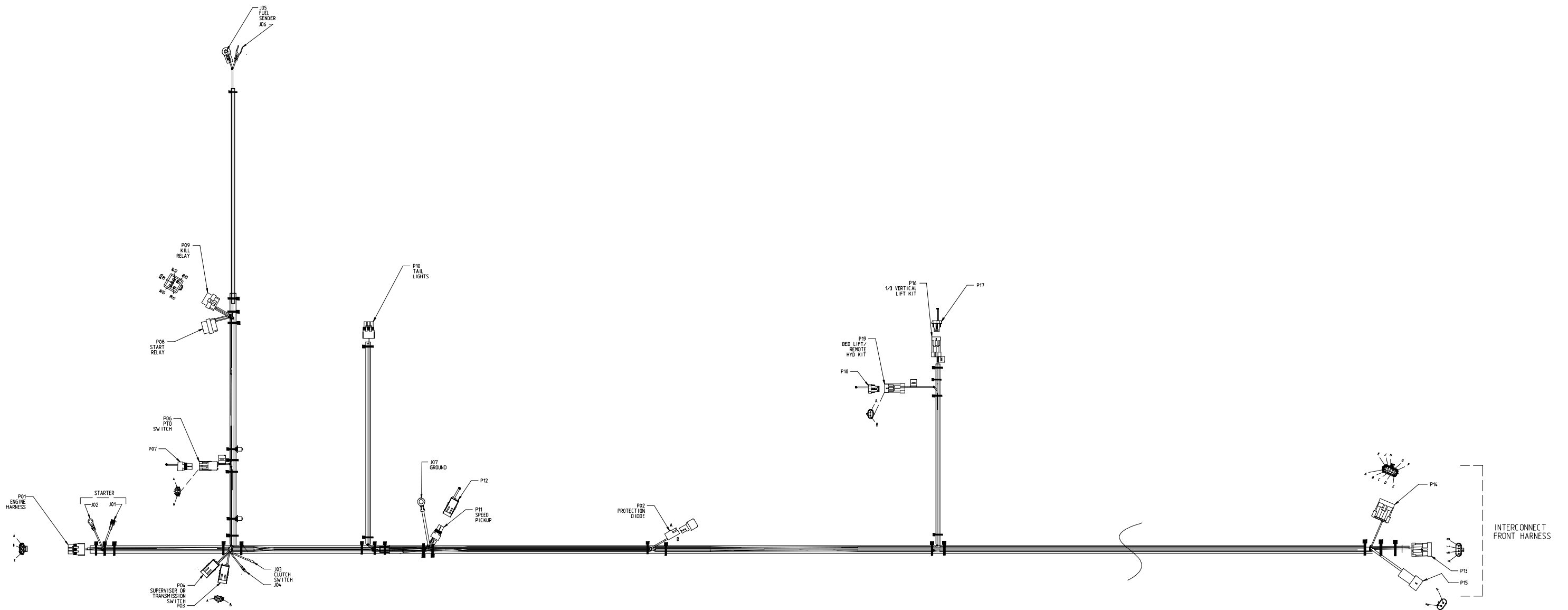
Workman 3100
Kohler Gasoline Engine
Rear Wire Harness
Serial Number Below 260000000



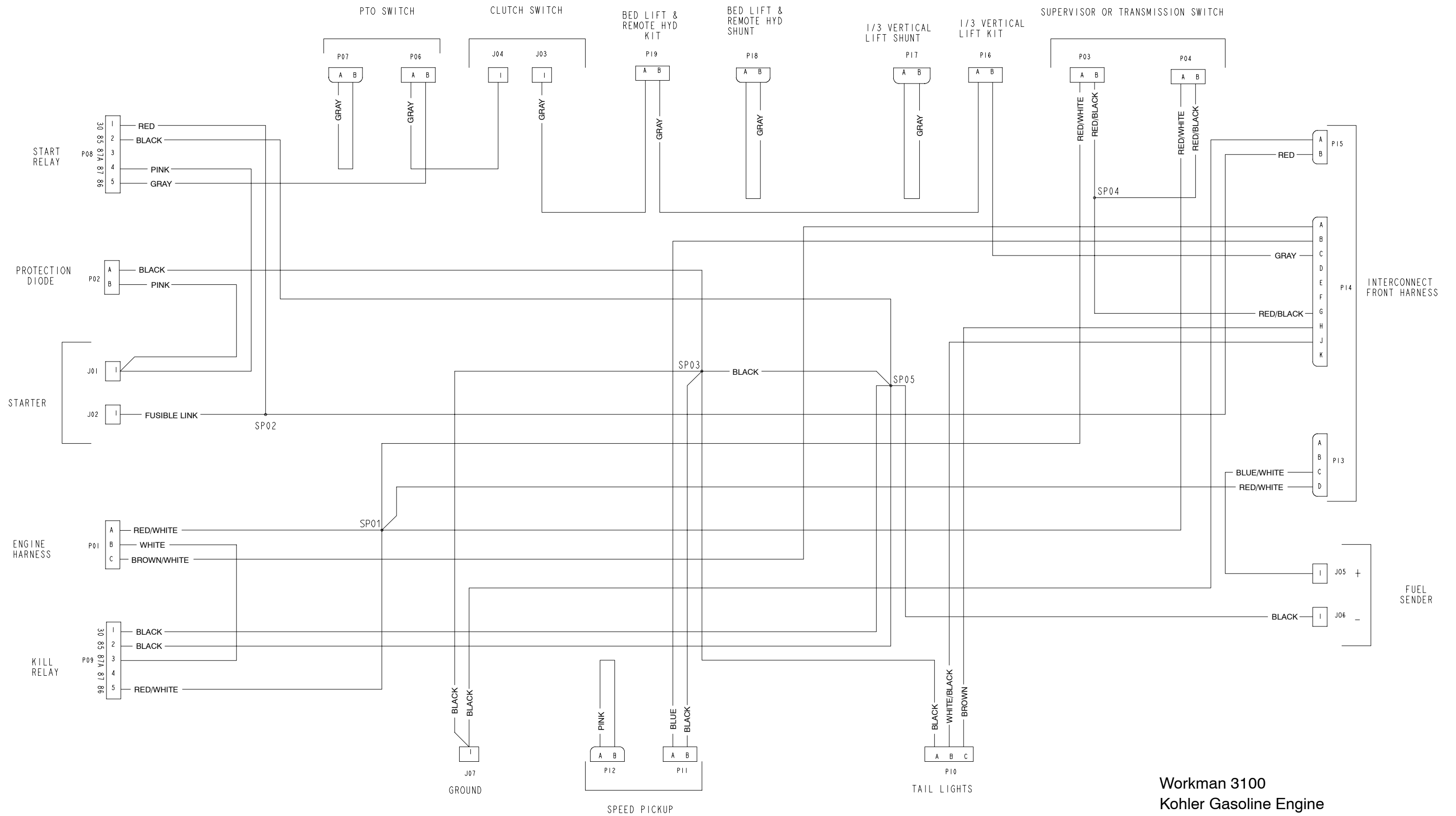
WIRE LIST

WIRE	COLOR	DESTINATION	DESTINATION
1	RED/WHY	ENGINE HARNESS	SPICE "C"
2	WHITE	ENGINE HARNESS	KILL RELAY
3	BRN/WHY	ENGINE HARNESS	FRONT HARNESS
4	PNK/BLU	STARTER	DIODE
5	PNK/BLU	STARTER	START RELAY
6	GRAY	STARTER	SPICE "A"
7	BLACK	DIODE	SPICE "B"
8	RED/WHY	SUPR SWITCH TRANS	SPICE "C"
9	RED/BLK	SUPR SWITCH TRANS	SPICE "D"
10	RED/WHY	SUPR SWITCH TRANS	SPICE "C"
11	RED/BLK	SUPR SWITCH TRANS	SPICE "D"
12	GRAY	START RELAY	PTO SWITCH
13	GRAY	CLUTCH SWITCH	PTO SWITCH
14	PINK	SPICE "A"	START RELAY
15	GRAY	CLUTCH SWITCH	FRONT HARNESS
16	BLACK	SPICE "E"	SPICE "B"
17	BLACK	SPICE "E"	START RELAY
18	BLACK	SPICE "E"	START RELAY
19	BLACK	SPICE "E"	FUEL SENDER
20	RED/WHY	KILL RELAY	SPICE "C"
21	BLU/WHY	FUEL SENDER	FRONT HARNESS
22	BROWN	TAIL LIGHT	FRONT HARNESS
23	WHY/BLK	TAIL LIGHT	FRONT HARNESS
24	BLACK	TAIL LIGHT	SPICE "B"
25	BLACK	GROUND	SPICE "B"
26	BLACK	GROUND	FRONT HARNESS
27	BLACK	SPEED PICKUP	SPICE "B"
28	BLUE	SPEED PICKUP	FRONT HARNESS
29	RED	FRONT HARNESS	SPICE "A"
30	RED/WHY	FRONT HARNESS	SPICE "C"
31	RED/BLK	FRONT HARNESS	SPICE "D"
32	GRAY	PTO SWITCH PLUG	PTO SWITCH PLUG
33	PINK	SPEED PICKUP PLUG	SPEED PICKUP PLUG
34	BLACK	SPICE "E"	START RELAY

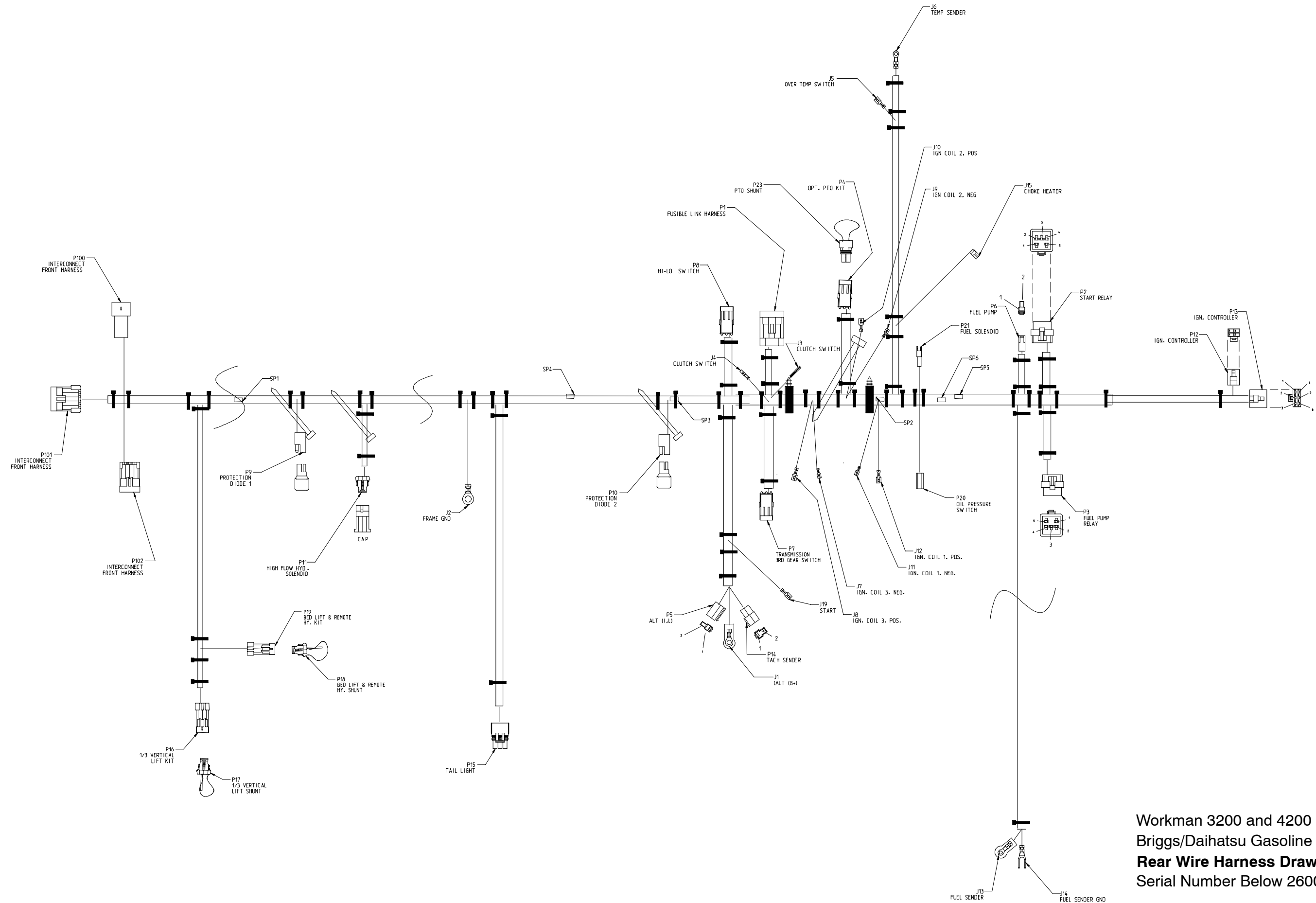
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 Kohler Gasoline Engine
Rear Wire Harness
 Serial Number From 260000001 To 260000400



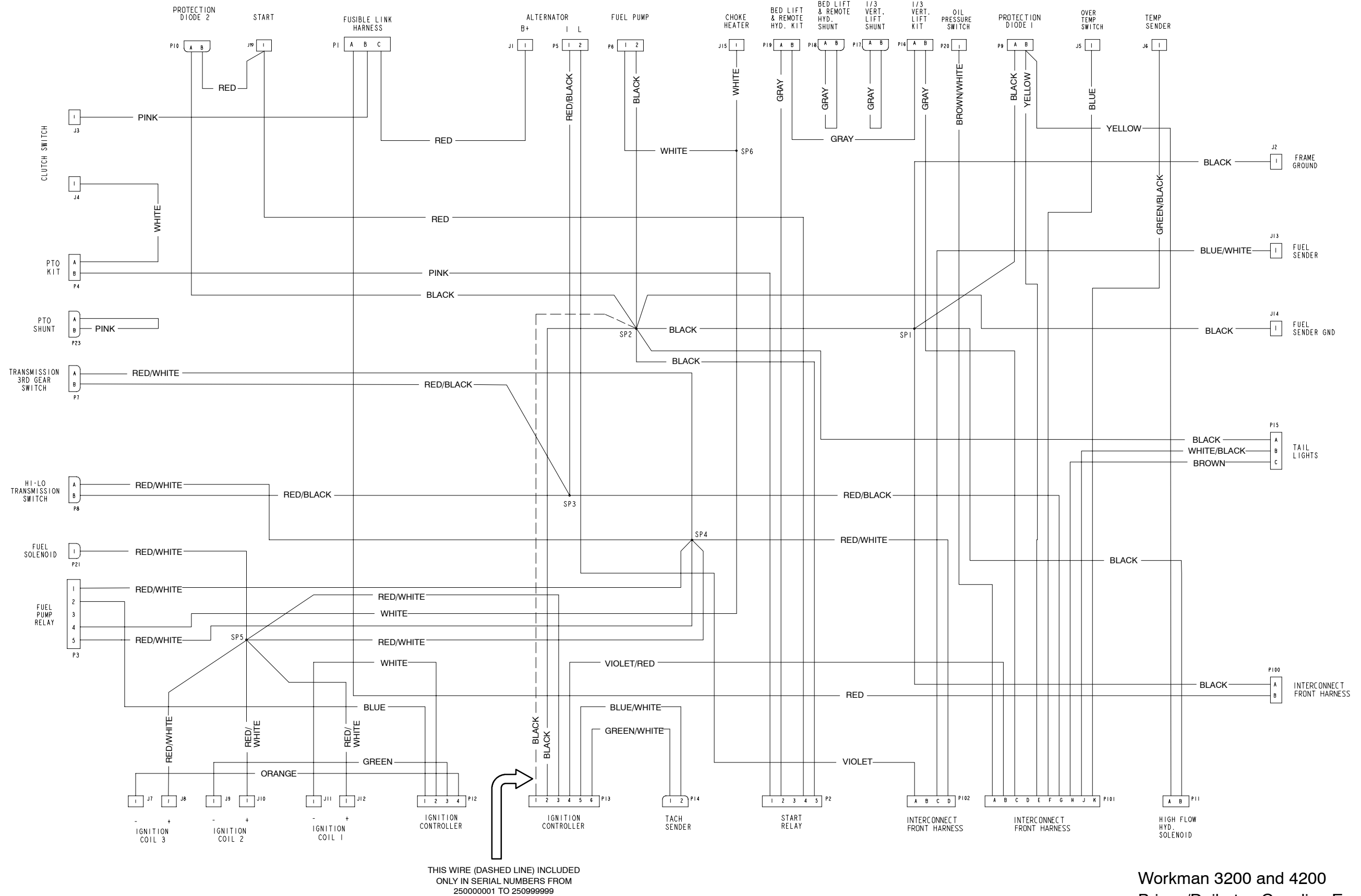
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Kohler Gasoline Engine
Rear Wire Harness Drawing
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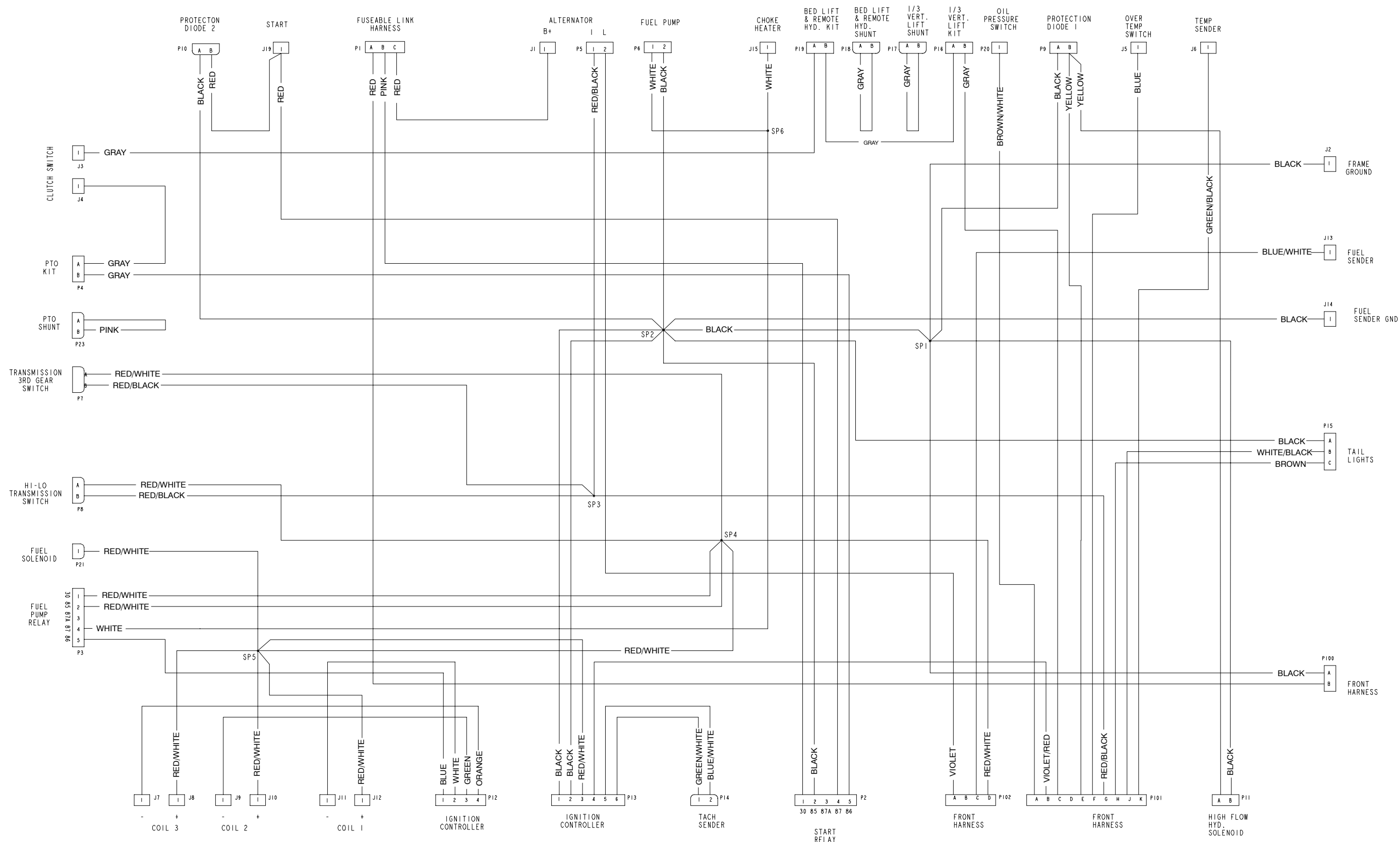
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Kohler Gasoline Engine
Rear Wire Harness Diagram
Serial Number Above 260000400



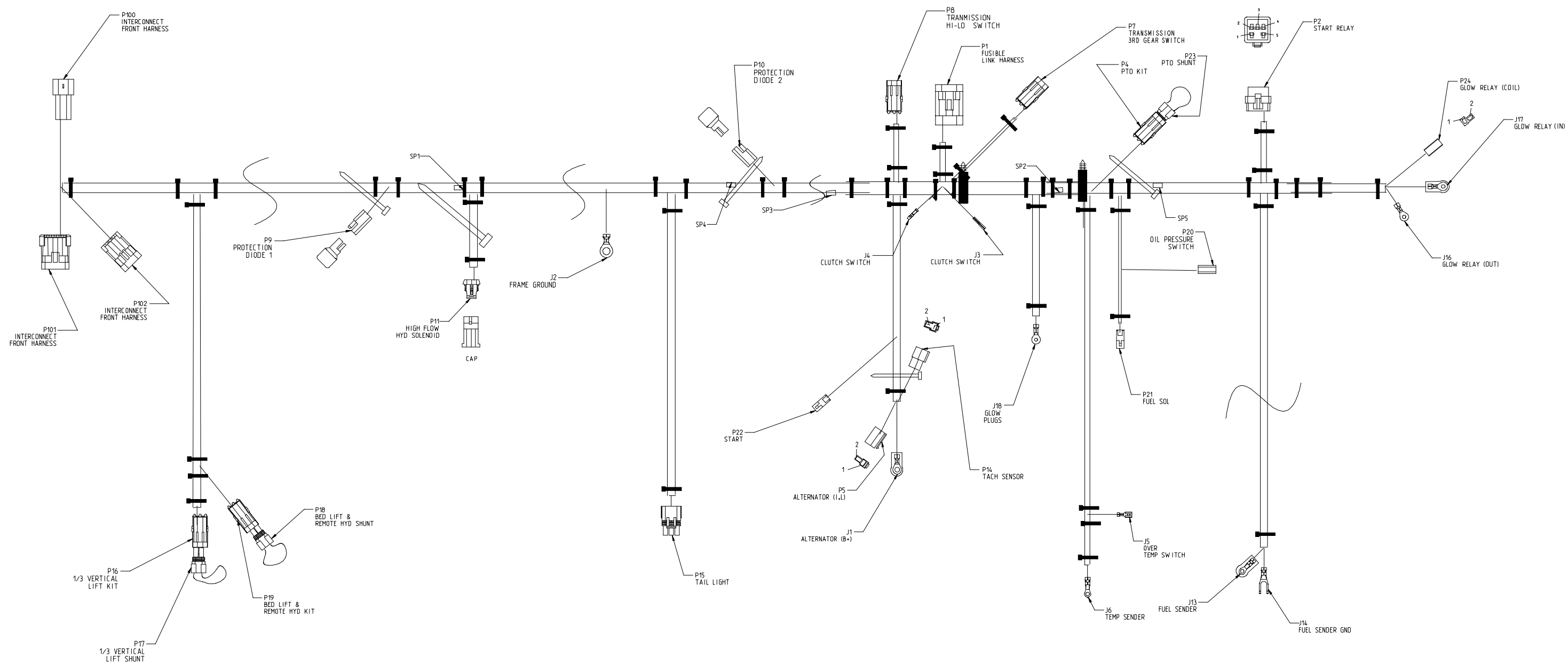
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Briggs/Daihatsu Gasoline Engine
Rear Wire Harness Drawing
Serial Number Below 260000000



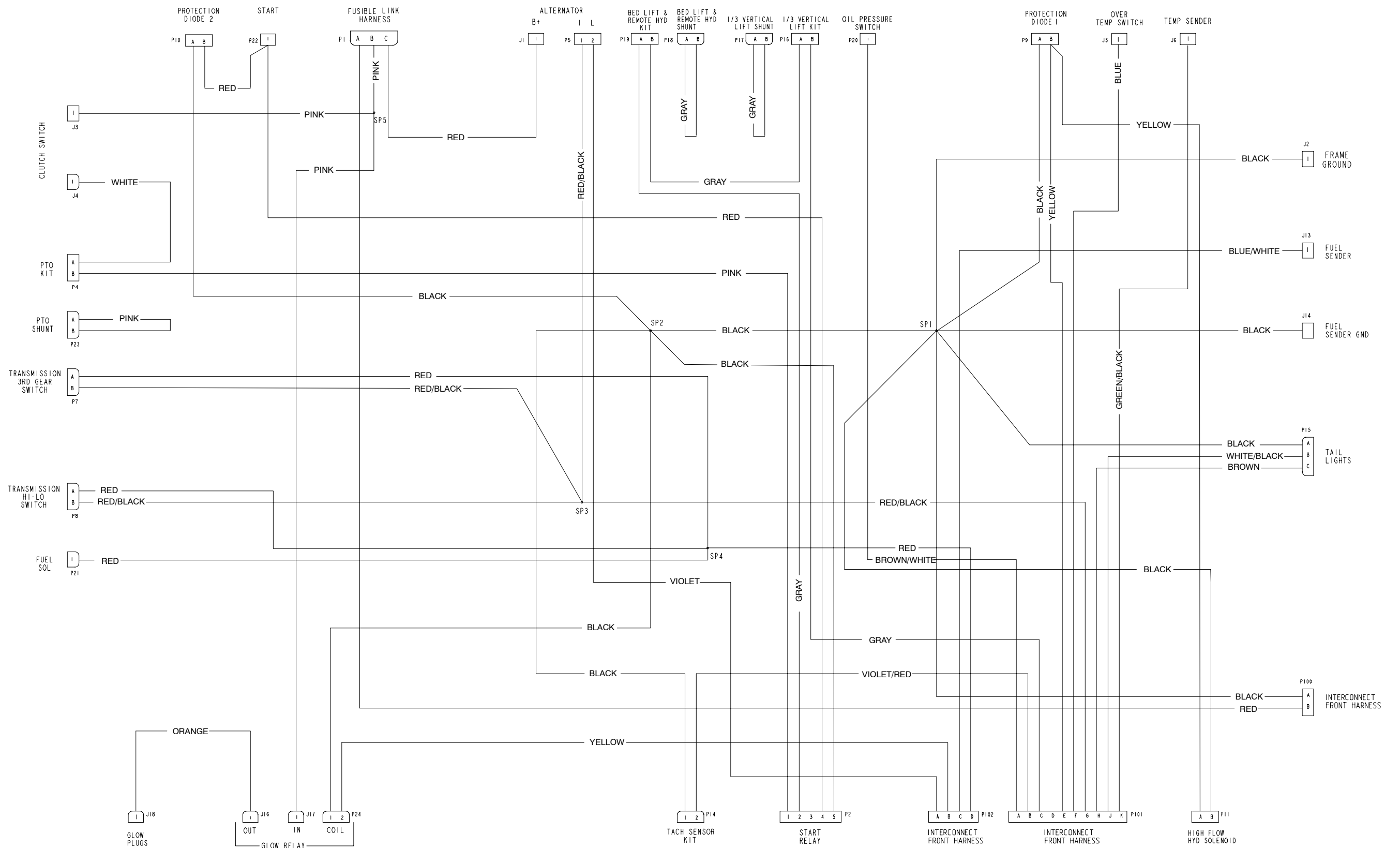
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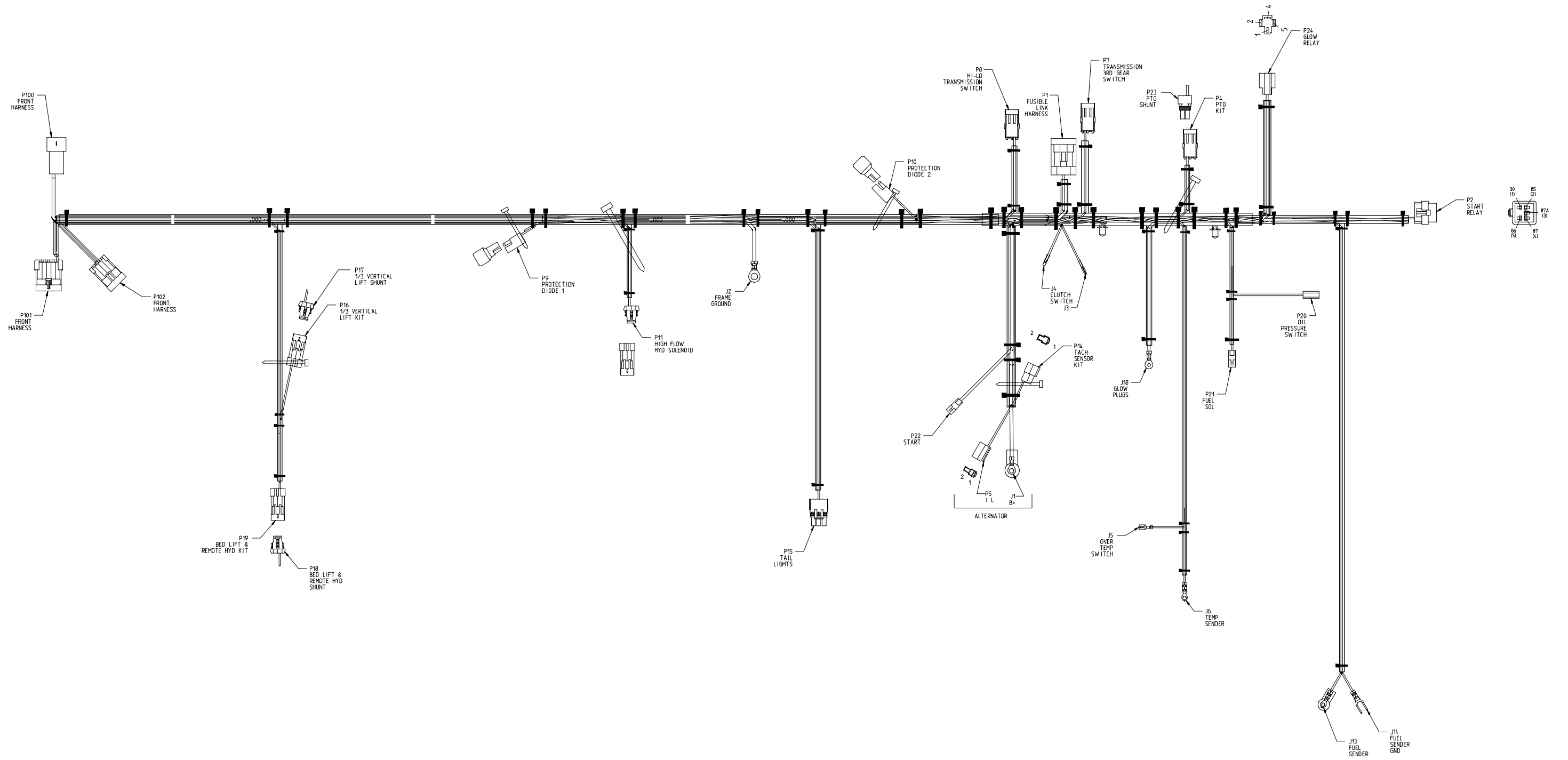
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Rear Wire Harness Diagram
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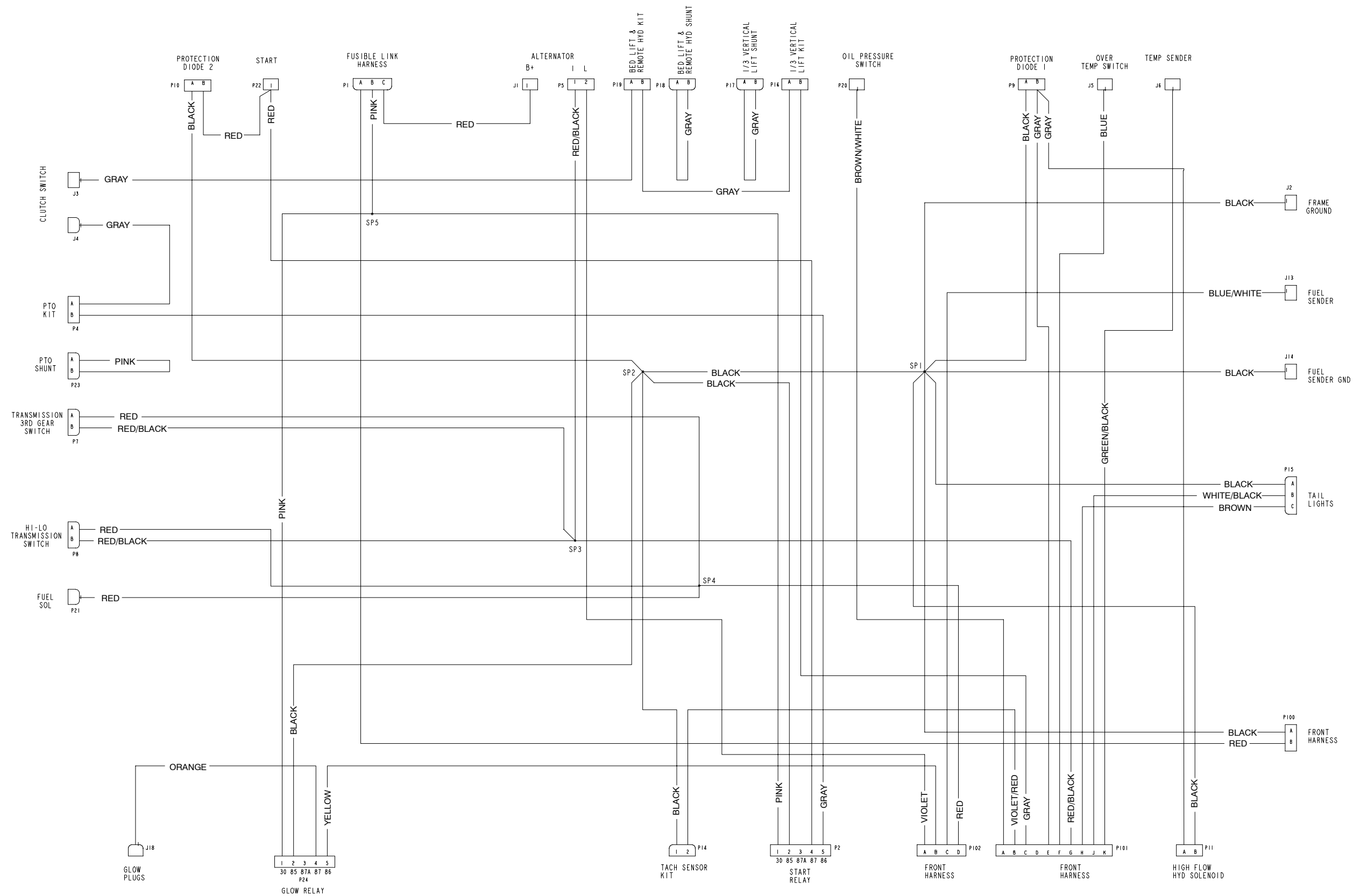
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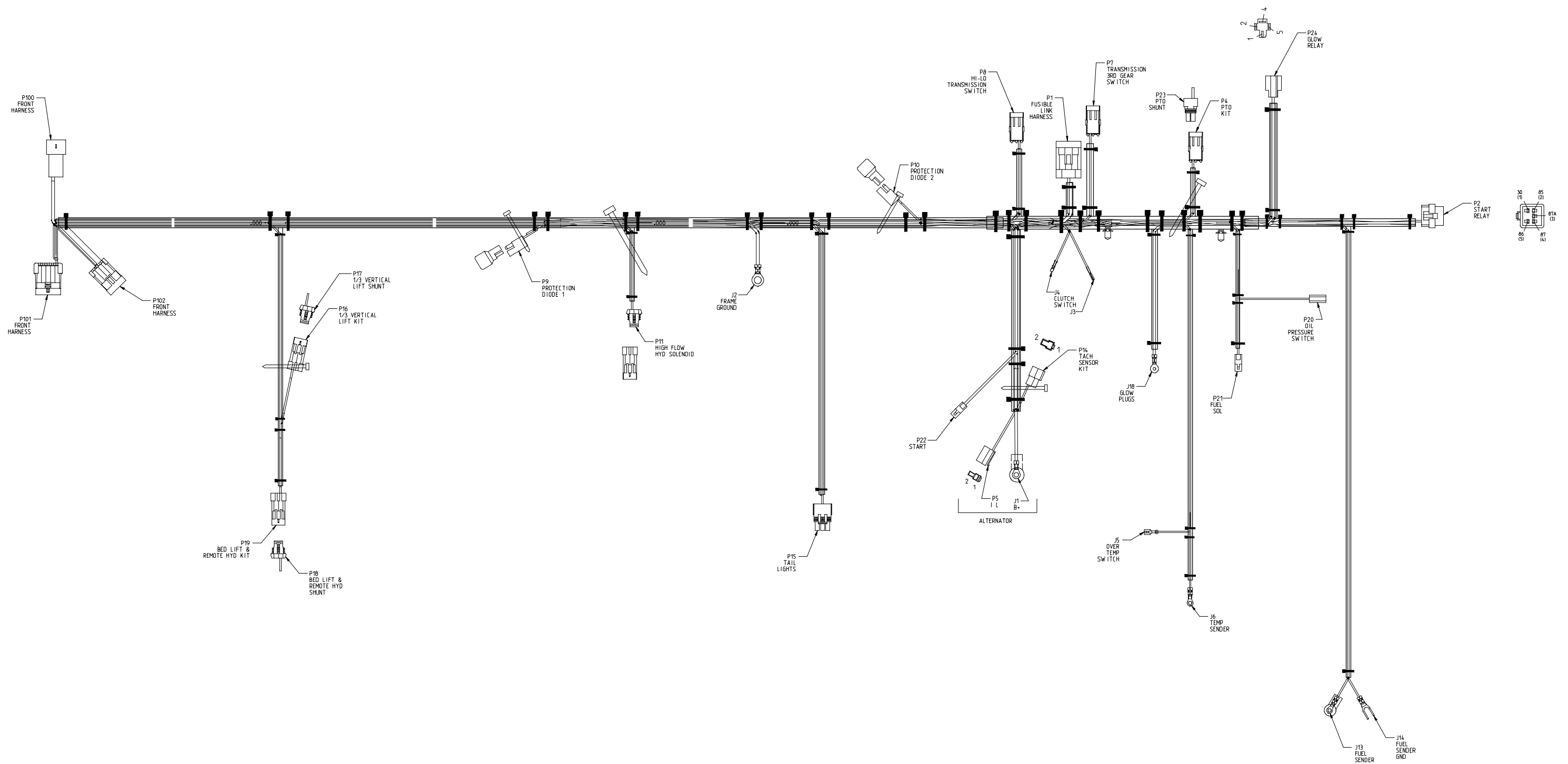
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Rear Wire Harness Diagram
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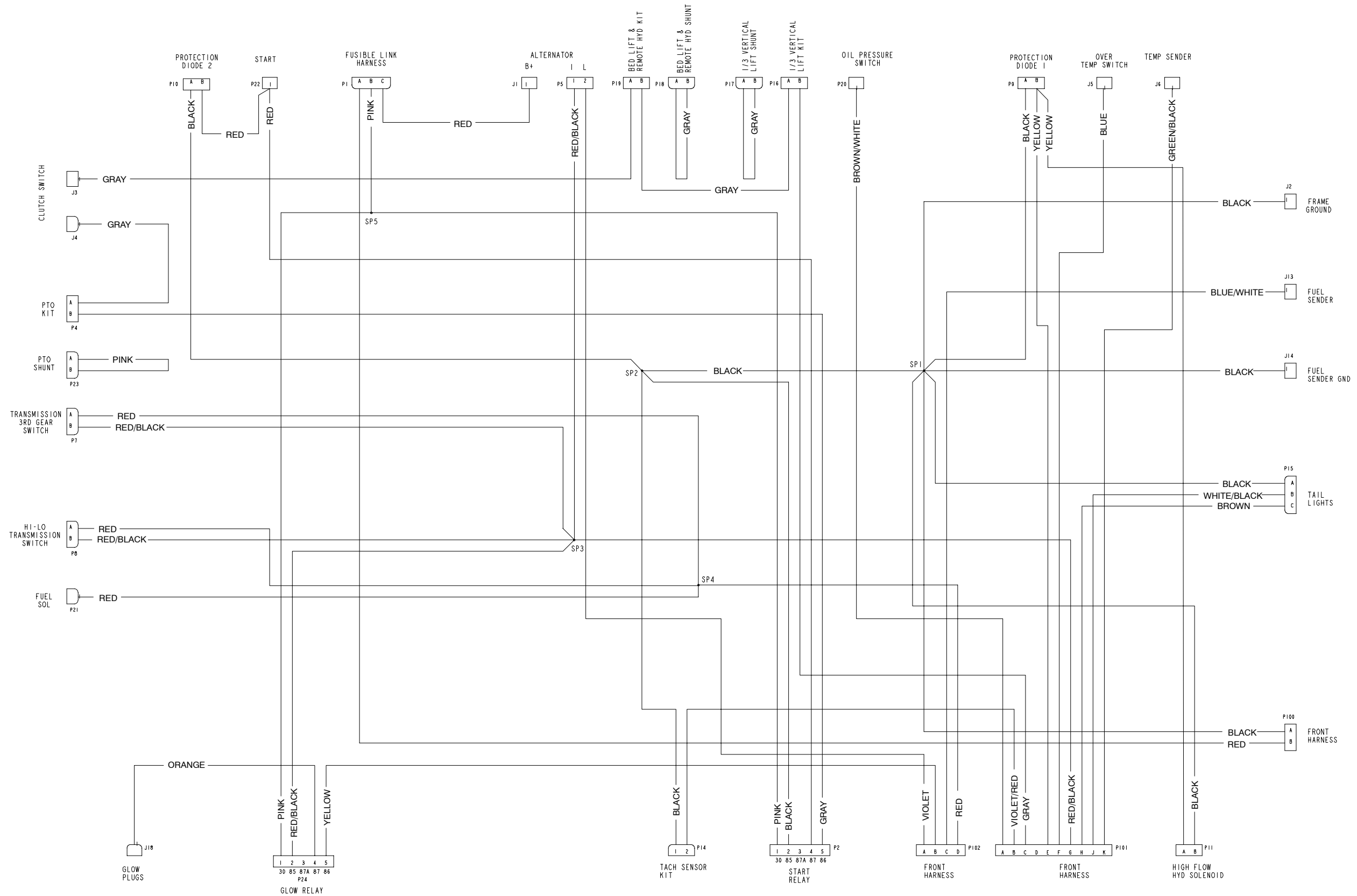
Workman 3300 and 4300
 Briggs/Daihatsu Diesel Engine
Rear Wire Harness Drawing
 Serial Number From 260000001 To 270999999



Workman 3300 and 4300
Briggs/Daihatsu Diesel Engine
Rear Wire Harness Diagram
Serial Number From 260000001 To 270999999



Workman 3300 and 4300
 Briggs/Daihatsu Diesel Engine
Rear Wire Harness Drawing
 Serial Number Above 280000000



Workman 3300 and 4300
Briggs/Daihatsu Diesel Engine
Rear Wire Harness Diagram
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